WIN HIFI GEAR WORTH $6000

BONUS: 100-PAGE CATALOG FROM ALTRONICS

Australia's Top Selling Electronics Magazine

NDD

Electronics Australia

FEBRUARY 1989

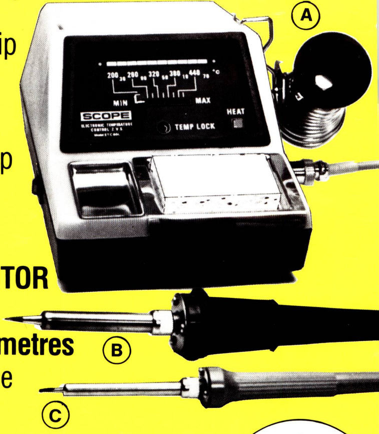
Aust* $3.95
NZ $5.50 incl GST

Exclusive Preview: Sony's New VIDEO WALKMAN

EXPERIMENTAL FIBRE-OPTIC LINK ★ RGB VIDEO ADAPTOR
TRACER FOR PCB SHORTS ★ TECHNICS 'PRO' CD PLAYER
FEATURES ON POWER SUPPLIES, CABLES & CONNECTORS

WHAT OTHER PROFESSIONAL SOLDERING STATION . . .

1. Provides both **60W and 30W** pencil irons that are instantly interchangeable.



2. **Constantly displays** the tip **temperature** you **SELECTED.**
3. **Constantly displays** the tip **temperature** ACTUALLY **BEING ACHIEVED.**
4. Lets the supervisor **MONITOR** actual tip temperature being used **from several metres distance** by glancing at the 3 COLOUR LED BAR'S
5. Lets the supervisor **LOCK** the temperature selector to **prevent unauthorised change** of soldering conditions.

$10* REFUND

Purchase this Station (either A & B or A & C) Send a Copy of this Adv. plus your Feb. Invoice to Scope to claim your $10 refund.

NO OTHER PROFESSIONAL SOLDERING STATION ON THE AUSTRALIAN MARKET DISPLAYS THIS MUCH DATA AND BUILDS IN THIS MUCH FLEXIBILITY TO ENSURE
HIGH RELIABILITY SOLDERING

SCOPE
Tel.: (03) 338 156
Fax: (03) 338 567

JMS255

* Offer expires 28 Feb. 89 – Scope P.O. Box 63, Niddrie 3042

Electronics Australia

Volume 51, No.2

February 1989

AUSTRALIA'S LARGEST SELLING ELECTRONICS MAGAZINE – ESTABLISHED IN 1922

A new era in personal video

Sony is just about to release its new GV-8 'Video Walkman' — a tiny personal VCR/colour TV combination. See page 18 for our exclusive preview of the product that could change the way we look at video.

Projects to build

We have plenty of construction projects for you this month: a low cost locator for short circuits on PCBs, an experimental audio link using fibre-optic cable, a new low-distortion audio oscillator, a TTL-analog converter for RGB colour video, and the final part of our 'real world' interface for computers – the input/output driver boards.

Power supplies feature

Choosing a regulated DC power supply can be tricky, with three different kinds available: linear, switching and ferro-resonant. The pros and cons of each type are explained in our article starting on page 118.

On the cover

Like the rest of us, EA's production editor Penny Roberts found Sony's new Video Walkman intriguing. Somehow this picture seemed to encapsulate the product's undoubted appeal – see page 18. (Photo by Peter Beattie)

Features

10 **BUYING A COMPUTER IN HONG KONG** *Beware of counterfeits!*
16 **LOOKING AT THE LEADING EDGE** *'Beyond 2000' Exhibition*
22 **WHEN I THINK BACK...** *The Ross Hull story*
40 **CABLING & CONNECTORS** *A guided tour of what's available*
116 **PRODUCT REVIEW:** *PSPICE – low cost circuit emulation*

Entertainment Electronics

6 **WHAT'S NEW IN ENTERTAINMENT ELECTRONICS** *Video, audio*
18 **SONY'S NEW GV-8 'VIDEO WALKMAN'** *Our exclusive preview*
36 **COMPACT DISC REVIEWS** *Liszt, Mozart, Caruso & Elgar*
50 **REVIEW: TECHNICS SL-P1200 'PRO' CD PLAYER** *Wow!*

Projects and Technical

54 **THE SERVICEMAN** *You scratch my back; and remember valves?*
70 **INEXPENSIVE PCB SHORTS LOCATOR** *Easy to build...*
76 **OPTO LINK AM-1** *Experiment with fibre optic communications!*
84 **NEW LOW DISTORTION AUDIO OSCILLATOR – 1** *Very flexible*
88 **TTL-ANALOG VIDEO CONVERTER** *Put that old monitor to use*
98 **UNIVERSAL "REAL WORLD" INTERFACE FOR PCS – 4**
104 **CIRCUIT & DESIGN IDEAS** *Fan controller, charging dry cells*
106 **REFERENCE NOTEBOOK:** *Common connections*
118 **POWER SUPPLIES FEATURE:** *Choosing a regulated DC supply*
124 **POWER SUPPLIES FEATURE:** *New Products and Services*
126 **BASICS OF SMALL DC MOTORS** *How they work*
128 **INTRODUCTION TO HIFI – 22** *More on loudspeaker systems*
132 **BROADCAST BAND LOOP ANTENNAS – 2** *A passive loop*
134 **VINTAGE RADIO** *The Atwater Kent 20C*
136 **SOLID STATE UPDATE** *High voltage stereo driver, new fast CMOS*

News and Comment

4 **LETTERS TO THE EDITOR** *Kit repair service, sexism claim*
5 **EDITORIAL** *Something for almost every reader, old or new...*
30 **FORUM** *When 'double insulated' very definitely doesn't mean safer!*
58 **NEWS HIGHLIGHTS** *AWA fibre optics for Aust. Army*
68 **SILICON VALLEY NEWSLETTER** *Texas scores the Supercollider*
110 **NEW PRODUCTS** *20GHz digital sampling scope, new Laserjet*
140 **INFORMATION CENTRE** *Answers to readers' queries, puzzlers*

Departments

12 **COMING NEXT MONTH**
75 **BOOK REVIEWS**
143 **EA CROSSWORD PUZZLE**
143 **50 AND 25 YEARS AGO**
145 **MARKETPLACE**
146 **DIRECTORY OF SUPPLIERS**
142 **NOTES AND ERRATA**

MANAGING EDITOR
Jamieson Rowe, B.A., B.Sc., SMIREE
TECHNICAL EDITOR
Peter Phillips, B.Ed., Dip.Ed., ECC
PRODUCTION EDITOR
Penny Roberts
EDITORIAL STAFF
Rob Evans, CET (RMIT)
Mark Cheeseman
CONTRIBUTORS
Neville Williams, FIREE, VK2XV
Ian Pogson, VK2AZN
Ron Cooper
Jim Lawler, MTETIA
Bryan Maher, M.E., B.Sc.
Ken Pohlmann, M.S., B.S.
DRAFTING
Karen Rowlands
GRAPHIC DESIGNER
Brian Jones
ART PRODUCTION
Alana Horak, Larry Leach
PRODUCTION
Kylie Prats
SECRETARY
Allison Tait
ADVERTISING PRODUCTION
Brett Baker
ADVERTISING MANAGER
Selwyn Sayers
PUBLISHER
Michael Hannan
HEAD OFFICE,
EDITORIAL & ADVERTISING
180 Bourke Road, Alexandria, NSW 2015
P.O. Box 227, Waterloo 2017.
Phone: (02) 693 6620
Fax number: (02) 693 9935 Telex: AA74488
For reader services see back of magazine.
INTERSTATE ADVERTISING OFFICES
Melbourne: 221a Bay Street, Port Melbourne,
Vic. 3207. Phone: (03) 646 3111
Fax No: (03) 646 5494, Nikki Roche
Brisbane: 26 Chermside Street, Newstead,
Qld 4006. Phone: (07) 854 1119
Fax No: (07) 252 3692, Bernie Summers
Adelaide: 98 Jervois Street,
Torrensville, SA 5031.
Phone: (08) 352 8666
Fax No: (08) 352 6033, Mike Mullins
Perth: 48 Clieveden Street, North Perth.
Phone: (09) 444 4426, Des McDonald
New Zealand: Rugby Press, 3rd Floor,
Communications House, 12 Heather Street,
Parnell, Auckland New Zealand.
Phone: 796 648 Telex: NZ 63112 'SPORTBY'
ELECTRONICS AUSTRALIA is published monthly by Federal Publishing Company Pty Ltd, 180 Bourke Road, Alexandria, N.S.W. 2015.

Copyright © 1988 by the Federal Publishing Company Pty Ltd, Sydney. All rights reserved. No part of this publication may be reproduced in any way without written permission from the Publisher or Managing Editor.

Typeset and printed by Hannanprint, 140 Bourke Road, Alexandria, NSW for The Federal Publishing Company Pty Ltd.
Distributed by Newsagents Direct Distribution Pty Ltd, 17 Doody Street, Alexandria NSW 2015
Registered by Australia Post – publication No. NBP 0240 ISSN 0313-0150
*Recommended and maximum Australian retail price only.

Letters to the editor

Kit repair service

Having completed your Playmaster Series 200 Amplifier (March 1985) from a kit, and after checking out all the works, i.e., solder joints, position of IC's etc., I switched on the power – what a disappointment! The damn thing would not work properly! Some of the LED's would not go out or on – distorted sound – "MUTE" and "STEREO/MANUAL" switches not working etc. I will not burden you with all the defect details.

After many attempts to fix the problems, things only got worse. But a year or so later my amplifier was saved by an article in "Forum" column of April '88. You made a mention of Hycal Instruments Fix-A-Kit, whom I contacted. I spoke to a Mr Stephen Calder, who gave me clear instructions how to get there and where to park etc.

To make a long story not so long, my amplifier was fixed and working really well in 3 days, even though he had warned that it might take from a week to two weeks to fix.

This is the reason for this note; I cannot recommend Mr Fix-A-Kit too highly. The service was very professionally carried out, with a written report of what I ballsed up, plus some faulty components replaced. The labour charge was most reasonable and all workmanship guaranteed for three months.

John Jansons
Padstow Heights, NSW

Sexism

I have been a subscriber to *Electronics Australia* since April 1961. Your magazine has kept me up to date with electronics over this period and I am very grateful.

However I must protest at the objectionable and insensitive lack of awareness which is evident in the inclusion in your magazine of "Kit's Column", part of an advert of Jaycar Electronics (Nov, p62).

As one who has spent considerable energies in assisting in my work role to eliminate sexual harassment from the work place in two major commercial organisations, I must object to the male fantasy which not only believes that sexual harassment of women by men is enjoyed by the victims, but is also good advertising copy.

The reality, as I have heard from many, many women who have been subjected to this particularly obnoxious male behaviour, is a long way from the fantasy projected in "Kit's Column".

I appeal to you to take steps with Jaycar to remove this column from your otherwise excellent magazine.

Brian Beck
Gympie, Qld.

Project safety

I am deeply concerned about a dangerous trend in the design of mains powered projects employing plastic boxes. Several recently published designs (not in *Electronics Australia*) have used a metal toggle mains switch on the front panel. Each has made NO provision to earth this switch or the associated controls on the same panel.

There is a very real possibility in these designs of the front panel and all the controls on it becoming live at full mains potential and so presenting a lethal hazard to anyone using them.

All that is required for this to happen is that the mains switch suffers an internal collapse due to accident or abuse. The chances are very high that this would render the switch frame live and hence the front panel and all the metal switches and controls on it would be capable of delivering a lethal shock.

One such project was claimed to be designed to comply with SAA regulations, but in fact all fail hopelessly in the most fundamental of them, the requirement for exposed metal parts to be earthed. (Australian Standard 3100, Section 5.3.1. page 20).

If the front panels were of aluminium and securely connected to mains earth then a least this requirement could be met. This has always been standard safety practice for mains powered appliances.

It is my experience that toggle switches, both large and small, are prone to internal collapse and this has been verified by other technicians I am acquainted with. Those contacted all agree the designs concerned are very dangerous.

I sincerely hope that responsible proj-ct designers will recognise the special equirements presented when using a lastic box in regard to mains wiring afety. The use of plastic switches and ontrols is essential unless a fully mains arthed arrangement is employed. (Be-ware: a plastic box does NOT equal ouble insulated).

Philip Allison
Sydney, NSW

Safety of electronic kit sets

The safety of electrical articles con-tructed by members of the public from it sets supplied by shops has come to he attention of the Electrical Approvals Advisory Committee. The Committee has requested that all manufacturers and distributors be reminded of the potential dangers of such products and o ensure the safety of the finished product by correct and careful design.

In addition it is requested that appro-priate instructions accompany the prod-uct in order to minimise the chances of a constructor, who would not be ex-pected to have detailed knowledge of electrical safety standards, assembling and operating the product in an unsafe manner.

Department officers are generally available to discuss any matters of con-cern in this regard.

G Rose
Director-General
Department of Minerals and Energy
Telephone (02) 234 4444.

Correction

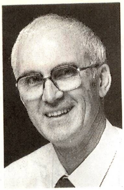
I refer to my letter published in the November edition of *Electronics Australia*, (page 6), titled 'Superhet inventor'.

If you compare my original letter with the letter as printed in *Electronics Australia* for November 1988, you will note that in the second paragraph the entire sentence: 'By comparison, Levy's patent was filed in Paris on 4th August 1917' has been omitted from your magazine.

It is unfortunate that this omission has been overlooked by your proof-readers as it is the date of filing of Levy's patent, viz., 4th August 1917, which is the focal point of the matter discussed. I trust you will have this matter corrected in a future issue of *Electronics Australia*.

Winston T Muscio
Leumeah, NSW

Comment: Our apologies for this omission – a typographical error that we didn't spot.



Editorial Viewpoint

Something for almost every reader, old or new...

Hello again. We have lots of interesting and informative reading for you this month, I'm happy to say.

Among the articles near the front of the magazine you'll find a very readable introduction to the subject of cables and connectors, by our new Technical Editor Peter Phillips. Like Peter's articles in recent issues dealing with electronics troubleshooting, this one is again intended for the newcomer, and if you're in that category I'm sure you'll find it very helpful.

With this issue we're also launching a new regular column by our former editor-in-chief, Neville Williams.

After he retired a few years ago, Neville had to reduce his involvement with the magazine due to pressure from other committments. But lately these have eased a little, and he has now agreed to write for us again on a regular basis. His new column is called 'When I Think Back...', and the idea is to share with us some of the wealth of experience he has gained over a very long career in the Australian electronics industry. His first article is about the short but but very active life of his and my mutual predecessor, Ross Hull – who died tragically just before Neville himself joined the magazine. I certainly found this story intriguing, and I feel sure you will too.

Another feature in this issue is my own preview of Sony's new GV-8 'Video Walkman', a tiny personal video unit which combines a video cassette recorder with a colour TV set based on a 3″ LCD screen. Sony is releasing this on the market next month, and it could well launch a revolution in video viewing habits.

We have some really good construction projects for you this month, too. Colin Mitchell and the UFO people down in Melbourne have developed a neat little audio communications link using fibre-optic cable, and Colin describes not only how to build it but also a series of experiments designed to help you get a good practical 'feel' for fibre-optic technology and the way it's used.

EA staffer Mark Cheeseman presents his very elegant and low-cost design for a PCB short-circuits tracer, which I'm sure you'll also find very interesting. And there's Peter Phillips' design for an RGB video converter, designed to let you use an 'analog' monitor with an IBM-compatible computer producing TTL-level video signals. Not to mention the first of two articles describing a new low-distortion audio oscillator, by contributor Phil Allison.

That's just a sampling of some of the goodies we have for you in this issue. Preparing it all has certainly kept us busy for a month, and I hope you find our labours worthwhile.

Jim Rowe

Sony releasing 'Video Walkman', even smaller camcorder

At a media preview whose timing just allowed us to catch this issue, Sony Australia announced the release next month of two exciting new video-8 products: a compact 'Video Walkman' TV/VCR combination, and a new-generation camcorder weighing less than one kilogram.

One of the product areas we overlooked in last month's predictions of market trends was 'personal video' products – pocket and handbag-sized portable TV's and videos. And predictably, that's the very market area where Sony is about to release its latest innovative product, one which could well prove as significant as the company's previous cassette Walkman and CD Discman products: the Video Walkman.

Although it measures only 213 x 129 x 67, and weighs a mere 1.3kg complete with battery pack and cassette, the new GV-8 combines a complete video-8 VCR with a fully functional personal colour TV receiver, based on a 3″ diagonal TFT (thin-film transistor) active matrix LCD screen. The video monitor section can also be used to display external video input, while the VCR can record either off-air or from an external input. Sony can also provide a very compact matching camera, if required.

Sony itself is confident that the GV-8 will open up a host of new video applications. It incorporates many new technological innovations, including single IC chips to handle the VCR servo and video subsystems respectively, a very compact deck mechanism and a 3″ colour LCD screen offering highest resolution yet achieved: 92,160 pixels. This provides a clear, sharp picture even in bright daylight.

The TV receiver offers automatic digital tuning over the full VHF/UHF channel range, while the inbuilt VCR offers virtually all of the features found on larger models.

By special arrangement with Sony, *Electronics Australia* was lucky enough to obtain the only advanced sample in Australia of the PAL version of the GV-8, for a quick preview. You'll find our exclusive report later in this issue.

Sony's other new release next month is the CCD-V88E Handycam camcorder, first model to break the 1kg weight barrier. Measuring only 300 x 112 x 106mm, it weighs only 0.9kg without battery and cassette – thanks to a new deck mechanism 60% smaller and 50% lighter than that used in all current video-8 camcorders and VCRs (including the new GV-8 Video Walkman). But the new model isn't just smaller and lighter than its predecessors. It also offers improved picture quality, using a new high-density 2/3″ CCD image sensor with 495,000 total pixels (440,000 effective) with a minimum illumination rating of 7 lux. It also offers through-the-lens auto focusing, a 6:1 power zoom lens (12-72mm) and six shutter speeds, from 1/50th to 1/4000th of a second to allow crisp shooting of moving objects.

Also inbuilt is a date/time generator, plus a two-frame digital image store capable of storing two separate titles or other images in any of 8 colours, and with the added option of scrolling when these are superimposed on a scene or scenes. Like other Sony video-8 camcorders the new CCD-V88E features a flying erase head for glitch-free insert editing and scene matching, and AFM sound recording for high quality sound. Its recommended retail price is expected to be around $4000.

The new GV-8 Video Walkman and CCD-V88E camcorder products were unveiled in Sydney by Mr Minoru Morio, a director of Sony Corporation in Japan, who is also senior general manager of the corporation's Personal Video Group.

Pioneer 'Reference' CD player

The new PD-91 'Reference' compact disc player from Pioneer is described as the flagship of the company's range.

The PD-91 achieves heightened performance levels with the inclusion of twin 18-bit digital/analog converters with 8 times oversampling, effectively producing sound quality 8 times more accurate than with the conventional 16-bit DAC 4 times oversampling digital filters. The addition of 11 regulators and 16 power supplies prevents possible interference caused by the simultaneous use of other internal components, ensuring consistency of power supply and, consequently, sound quality.

All internal components of this unit are securely insulated from both external and internal vibration with the use of a laminated pick-up base, honeycomb chassis, large honeycomb insulators, magnetic-clamp disc stabiliser, and a coaxial suspension system with ceramic supports. The power transformer is located externally, reducing even further the possibility of electronic 'hum' and interference.

The player comes complete with the latest user features – such as time fade editing, auto program editing and 'Music Window'. Such features allow you to fade music in or out and program your recordings as required.

All aspects of the PD-91 are of a very high standard – including heavy duty gold-plated terminals to ensure constant performance over long periods of time. Constructed with a prestigious glossy black finish, genuine rosewood side panels and gold trim the player carries a RRP of $1999.00.

Car radio has remote control

In the living room the remote control now saves us from leaving our seats – to change the setting on the TV, VCR or hifi. Now the remote control that Philips has introduced with its latest car stereo system could very well keep motorists in their seats – and save lives.

Philips' new DC774 car tuner – cassette system comes with a neat remote control that you can place within easy reach of your hand. It lets you operate all the main controls without taking your eye off the road. The remote control is just one of the features which won the DC774, the coveted European 'IF' (Industrie Form) Design Award. With 40 watts of output power and Philips unique SOFAC (super audio control) multi-function control, the DC774 is a smart looking and reliable system for quality musical reproduction. And yes, the remote control can be passed from the front for a new level of back seat entertainment.

The DC774 is available in permanent or 'quick release' installations for around $949.00 at Philips car stereo specialists.

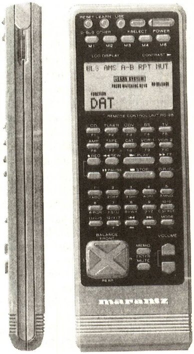
'One remote control fits all'

Tired of the growing clutter of remote control devices used to handle compact disc players, TV receivers, video cassette recorders and other audio and video components? Marantz Australia says it has come up with the best answer yet in its Universal Remote Commander RC583, claimed to be the most advanced and powerful remote control ever devised for audio and video equipment.

The unit is claimed to control all major functions for up to 10 different components – from any manufacturer. This means only one unit – the RC583 – is needed to control all remote-equipped audio-video equipment in the household, including compact disc players, amplifiers, tape cassette decks, AM/FM tuners, surround-sound processors, TV receivers, and video tape recorders.

The RC583 can also control the new digital audio tape (DAT) recorders and Compact Disc-Video players expected to be launched in Australia in the near future.

While there have been other universal-style commanders on the market, Marantz claims the RC583 is the first to incorporate a large liquid crystal display screen. The easy-to-read screen displays pre-programmed commands for each component, and also makes it a simple matter to program new commands via the RC583's 'Learn' system.



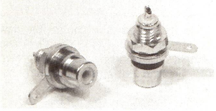
ISDN-based colour videophone

Toshiba's researchers have successfully developed a prototype colour videophone, which can send moving colour pictures smoothly by utilising the emerging Integrated Services Digital Network (ISDN).

The equipment integrates a telephone, a small camera with a CCD (charge coupled device) image sensor, and a 4" colour LCD display in one unit. Users can enjoy the phone conversation just as with an ordinary telephone, while seeing each other on the screen at the same time.

Toshiba's experimental video phone utilises a pair of 64kbps digital lines to transmit voice and visual information separately, and thus is designed to conform to 'INS Net 64' – the commercial ISDN service launched in Tokyo and other metropolitan areas in April, 1988 by Nippon Telegraph and Telephone Corporation (NTT). The screen image is composed of 5 to 10 frames per second, which is fast enough to capture changing facial expressions.

For the new videophone, Toshiba's researchers have developed a method to minimise the amount of information required to transmit the sender's image. The videophone continuously transmits the precise image of a human face utilising a density of picture elements four times greater than is used for transmission of the remainder of the picture, thus minimising the sum of data. Sophisticated software enables the videophone to verify the location of the human face 30 times per second by comparing the actual image with embedded knowledged concerning the human silhouette.



High quality RCA connectors

Not being happy about the quality of the RCA connectors that he could buy in Australia to go into his high-regarded ME Sound amplifiers, local designer and manufacturer Peter Stein has arranged to have some specially made overseas, to his own tight specification. Now he is making them available to anyone else who needs RCA connectors of known high quality and reliability.

Unlike many others, the connectors use heavy precision-machined barrels and central 'hot' contact clip. Both of these, the attachment nut and even the solder lug supplied are heavily gold plated for the lowest possible contact resistance and highest reliability. The insulation is also of high-quality Teflon.

A feature of the connectors is that the internal contact clip is recessed further than usual, to ensure that the outer earth connection is made first during plug entry, and broken last upon withdrawal. This prevents loud 'bangs' and 'hum bursts', which can cause not only irritation but damage to speakers, etc.

The connectors are available for $6.99 each from Speaker Technologies, PO Box 50, Dyers Crossing 2429. Phone (065) 50 2254, or fax (065) 50 2341.

New cassette deck from Akai

With the outcome of DAT still in a state of prolonged discussion, Akai has aimed its R&D into the development of a new high end cassette deck – the GX-95.

The GX-95 uses Akai's twin field super GX three head system, featuring separate heads for recording and playback on a single head core. Further, linear crystal oxygen free copper (LC-OFC) is used in the wiring of the twin field head and other critical parts, which is claimed to reduce signal transmission distortion and provide better electrical linearity. A proprietary motor assisted cassette door allows finger touch open and close control, also any one of the taping operations closes it again.

A Closed Loop DD Double-capstan Tape Transport system is used to maintain tape tension and optimise head to tape contact. The closed loop double-capstan system improves on conventional versions by offering different capstan shaft diameters, and thus reduces the likelihood of sympathetic resonance from one drive shaft to another. Three independent motors offer FG servo DD motor for the capstan, a DC motor for reel drive and a DC motor for controlling tape eject.

Akai claims it has gone to unprecedented extremes in ensuring the playback amplifier is as linear as current technology permits. To obtain this, it has utilised a high-tuned DC playback amplifier routing the signal from the playback head to the line outputs. No feedback, push-pull current drive circuitry is employed in the recording amplifier.

The GX-95 offers Dolby HX-Pro, Dolby B and C noise reduction systems. Technical specifications include frequency response 20Hz to 21kHz (metal); THD less than 0.6% (metal); signal to noise 59dB (metal) – further improved with Dolby B or C; wow and flutter 0.025% WRMS; line input; and CD/DAT direct in.

The GX-95 is covered by Akai's two year warranty, has an RRP of $1,299.00 and is available only at selected Akai dealers.

Highly compact hifi speakers

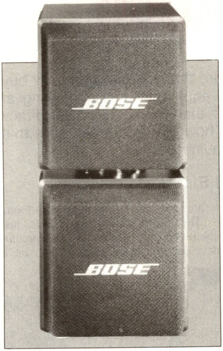
Finding the best place to put hifi speakers in your listening room is not always easy. Usually it must be a compromise between decor and sound quality.

In 1968 the 'big is best' syndrome was shaken by an American loudspeaker known as the Bose 901. This particular speaker was about one-tenth the size of its competitors, yet competed strongly in terms of performance.

The latest offering from Bose once more attacks the idea of size. The Bose Acoustimass speaker system was introduced to the Australian market last year and has met with a very positive reception.

The system is so small it has been called 'invisible', consisting of two pairs of extremely small, (9cm) cube speakers and an equally revolutionary new bass system. But although size has been a major design consideration, Bose claims that sound quality has not been compromised. The bass reproduction is said to rival speaker systems twice the price, and the overall reproduction of the system is smooth and detailed.

For further information contact Bose Australia, 11 Muriel Avenue, Rydalmere 2116 or phone (02) 684 1022.

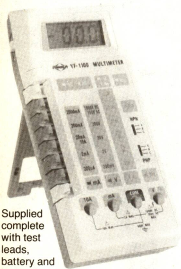
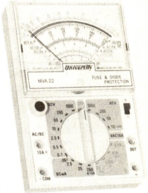


Recordable CDs closer

Japanese firm Taiyo Yuden has announced that it is preparing to manufacture a new recordable compact audio disc. Unlike the 'Thor' system announced recently by Tandy in the USA, the Taiyo Yuden recordable CD is apparently made from polycarbonate, similar to existing CDs. However moulded into the disc's surface is a spiral groove, which guides the recorder's laser.

According to reports, the recorder uses a solid-state laser with an output of only 9mW, but records using surface pits which can be played back in the normal way.

The recordings are not eraseable, and the discs cannot be re-used. However since the recorder allows a user to make CD-quality recordings and copies of commercial recordings at low cost, the International Federation of Phonogram and Videogram Producers has described recordable CDs as "an even greater potential threat than DAT". So like DAT, the new system may encounter considerable resistance from software producers.

FAMOUS MULTIMETERS

University MODEL YF-1100
HIGH PERFORMANCE
HAND HELD METER

University MODEL MVA 22

FEATURES:
Large 3½ digit 12mm LCD display reading to 1999. In-line push button switch for function and range selection. Wide viewing angle, easily read in bright or low-light conditions. 10 Megohm input impedance on both ac and dc volt ranges. Battery — 9V (Eveready 216) with provision for 240V/9V dc adaptor. 200mA and 10A ac and dc ranges, giving 100nA resolution. Auto-polarity and over-range indication on all ranges. Ohms ranges protected for 240 Volt ac and dc operation. All solid state CMOS circuitry for low power consumption. 4mm Recessed terminal sockets for absolute safety. Diode test facilities — 2.5V with max. test current 100mA. Multi-coloured, non-glare front label. "Low battery" indication displayed. Conventional one hand operation. Unique fold-away bench stand. Transistor testing facilities.

Supplied complete with test leads, battery and instructions.

University Service Instruments
New Attractive COLOUR Designs
the latest Circuitry
• ACCURACY • PERFORMANCE
• DEPENDABILITY

FEATURING BOTH
10AMP ac and dc RANGE
Load Current: 150, 1.5mA, 150mA
Load Voltage: 3V
Volume level: — 10/0/ + 62 dB
Accuracy: dc ±3%, ac ±4%
Batteries: 1.5V 2pce — 9V 1pce
Size: 146 × 97 × 30mm — 260g

DIGITAL MULTIMETERS
UNIVERSITY PATON INSTRUMENTS PTY LTD

OFFICES AT:
SYDNEY: (02) 53 0644
FAX: (02) 534 4002
MELBOURNE: (03) 370 5994
BRISBANE: (07) 52 9611

AGENTS:
WOLLONGONG: (042) 71 3844
NEWCASTLE: (049) 69 5177 & (049) 69-3122
SA: (08) 363 0277 & (08) 212 6235
WA: (09) 381 4477 & (09) 381 6422

ACT: (062) 80 4654
NZ: AUCKLAND: 68 7177
LOWER HUTT: 69 4876
TAS: (003) 31 9333
& (002) 34-2811

Buying a Computer in Hong Kong

No doubt many readers are aware that you can generally buy computers and other electronic equipment in Hong Kong at prices that are very much lower than those here. But piracy and counterfeiting abound – so how can you make sure that what you buying really is the genuine article?

by THOMAS E. KING

"Customs officers yesterday confiscated 6000 pirate computer manuals worth $600,000 (A$100,000) in one of the biggest raids of its kind in Hong Kong. Investigators acting on a tip swooped on a printing works in Quarry Bay and a binding factory in Kowloon Bay. Two businessmen were arrested and released on bail pending further inquiries."

While the value of this raid, reported on the front page of Hong Kong's *South China Morning Post* in mid 1988 was unusually large, it wasn't the first time such an event had been covered by the local press. Neither are similar stories rare, nor are they likely to stop being published. Because of demand and profit all forms of computer piracy are difficult to contain. (Such a predicament is obviously not limited to Hong Kong.)

Rather than responding to this situation with an 'if you can't beat them, join them' computer complex, long-term Hong Kong resident Tony Payne decided that there was a definite need for the establishment of an upmarket and legitimate computer mart housing major retailers and smaller outlets in the one purpose-built sales area.

The one-stop shopping idea isn't new, as the same concept has been used by department stores for years. Mr Payne, however, may well have been the innovator for one-stop computer shopping in the Far East, with the opening of his Asia Computer Plaza some five years ago.

Tony Payne first conceived the idea of a department store-like computer plaza in 1983. At that time, the Silvercord complex was under construction next to the prestigious Harbour City Centre and only a few minutes from the Star Ferry terminal at the extreme tip of Kowloon.

"The Silvercord Building was just about the only place able to accommodate our projected requirements on a single level," noted Mr Payne. "Space was what we needed and with the Silvercord's 50,000 square feet, space is what we got." (The Asia Computer Plaza office is at LG-1, Silvercord Building, 30 Canton Road, Tsimshatsui, Kowloon, Hong Kong, telephone 3 311 2611, telex 32257 KCCFX HX P.O. Box 98730, Kowloon Hong Kong.)

Around 40 shops located on the lower ground floor of the Silvercord Building sell virtually everything from personal computers and software to peripheral

The scene outside Hong Kong's Golden Shopping Arcade, which occupies a full city block in an area crammed with street vendors.

devices and books. (About the only thing not available is computer furniture!) As most of the outlets are members of the Hong Kong Tourist Association, buyers can purchase in confidence – knowing that if equipment is misrepresented or faulty or there is some other legitimate cause of complaint, a letter to the HKTA will receive attention.

This guarantee of quality is one reason why the plaza is particularly popular with consumers, who range from tourists coming as first-time computer buyers to professionals upgrading to a more advanced system.

The real target market of the Asia Computer Plaza is the executive and businessman rather than just the hobbyist. To reach this sophisticated audience on its own professional terms, several techniques have been used – including ongoing computer classes and seminars.

In addition, the buyer at the Asia Computer Plaza has the added benefit of an information centre, a library, a central file of computer users plus FOCUS (Federation of Computer Users and User Groups) to bring people with common interests and equipment together to share their knowledge and experience.

"It's all part of the process of demystification so that intelligent people who need computers don't feel intimidated by them," said Mr Payne.

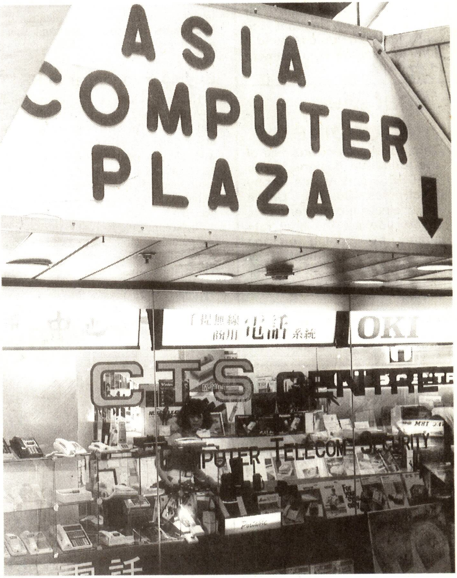
Not only does the Asia Computer Plaza lay claim to being the first one-stop computer shopping mall in the Far East, it's perhaps the only computer 'supermarket' in the region where the buyer-to-be can have hands-on demonstrations, discuss software compatibilities and capabilities and compare hardware systems all under the same air conditioned roof. Nearly everything is IBM compatible.

When the plaza first opened in 1984 two major names, IBM and Apple accounted for about two thirds of hardware and software sales. Today IBM's domination of the vast bulk of business has come about, Mr Payne noted, because of the company's policy to grant licences for manufacturers wishing to produce 'compatible' items. The Apple approach has been entirely different.

The Golden Shopping Arcade is also entirely different. Occupying a full city block, this multi-storey complex faces Yen Chow Street and is within a minute's walk from the Sham Shui Po MTR Station, (Hong Kong's Mass Rapid Transit system). One block behind the same station on the territory's underground railway is Apliu Street, with its multitude of shops selling com-

歡迎光臨
高登購物中心電腦商場
超過120間之商號為你提供
更多選擇價錢更平
WELCOME TO GOLDEN SHOPPING CENTRE
THE WIDEST CHOICE OF COMPUTERS IN
ASIA WITH OVER 120 SHOPS AT THE
MOST COMPETITIVE PRICES

A welcome sign inside the Golden Shopping Arcade, boasting of the 120 computer stores inside.



Tony Payne's Asia Computer Plaza, opened some five years ago in the Silvercord complex – near the Star Ferry terminal in Kowloon.

Coming next month in Electronics Australia

Low cost car tuneup adaptor

Here's a great project for those who like to work on their own car. It turns your multimeter into a handy tachometer, dwell meter and voltmeter combination for tuning up. Low in cost and easy to build, you can build it into the engine compartment if you wish.

'Beat Me' metronome

This novel project was one of the runner-up designs in our EA-DSE Grand Aussie Hobby Electronics Contest. Unlike other electronic metronomes, it lets you set the beat rate simply by tapping on the case – very convenient! Easy to build, it's much cheaper than a commercial metronome.

Note: Although these articles are being prepared for publication, circumstances may change the final content of the issue.

SONICS MAGAZINE

For: Musicians, Road Crews Recording Engineers, Lighting People, Managers, Promoters and anybody interested in what goes into today's music-making.

THE ALL AUSTRALIAN MUSIC MAKERS'MAGAZINE

Hong Kong...

ponents and electrical goods at prices far different to those in the more tourist-visited parts of the popular holiday destination.

Around 130 shops comprise the Golden Computer Centre. Found on three levels of the building, they carry every imaginable type of computer and accessory – quite a number never seen before outside Hong Kong – 'at most competitive prices';

The centre's well worn tiled floors are swept across daily by bargain-seeking local hobbyists and the occasional tourist who has by chance discovered this off-the-beaten track haunt for computer buffs.

After a thorough exploration, walk the area around the Golden Shopping Arcade. It's a fascinating education of a different kind with its street vendors hawking everything from jeans and housewares to exotic fruits and snake meat soup. Computers? There's not one in sight!

Buying a computer in HK

The first golden rule to follow when buying in Hong Kong is to shop around and compare prices before making any major purchase. (If you have time it's a wise idea to contact the relevant sole agent in Hong Kong and ascertain the recommended retail price, accessories included, and the type of guarantees expected.)

The second rule is to always deal with a reputable establishment such as Hong Kong Tourist Association members. These are easily identifiable as they display the well known 'junk' logo.

Be certain that the computer you buy is the one you really want. Unless the unit is faulty or misrepresented it is very difficult (usually impossible) to get a refund.

Ensure that you obtain a worldwide international guarantee, properly completed with the model and serial numbers, date of purchase, the name and address of the shop and the shop's official stamp or 'chop'. (Local guarantees are valid only in Hong Kong and local retailer guarantees have no value in Australia!)

Check that any separate attachments are included and that they do, in fact, belong to the specific computer purchased. Check that the instruction manual is included, as well.

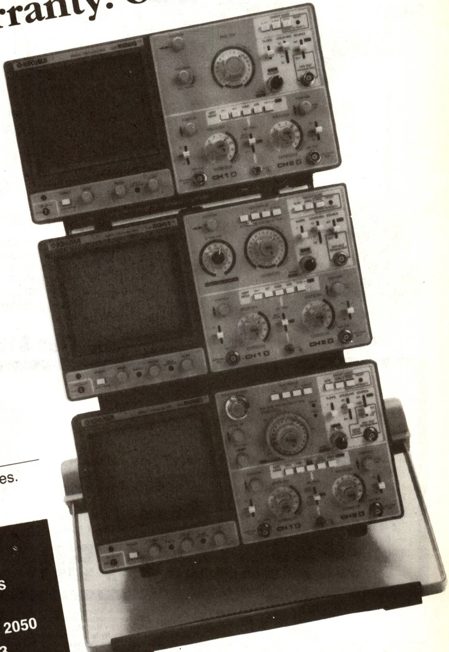
Unless the equipment purchased is small, don't expect to carry it as hand luggage on your return flight to Australia. As a rule it is virtually impossible to bring more than one bag on board your return flight. It's far cheaper to have something well packed and sent as unaccompanied baggage rather than pay excess baggage charges.

Anyone contemplating a buying trip to Hong Kong should contact the Hong Kong Tourist Association, National Bank House, 20th level, 255 George Street, Sydney, NSW 2000, telephone (02) 251 2855 for a useful publication "The Official Guide to Shopping, Eating out and Services in Hong Kong". Even those who can't organise their buying spree at this stage may wish to write for the publication and then contact relevant outlets in Hong Kong to enquire about mail order facilities. EA

Typical stores inside the Asia Computer Plaza in Kowloon. Most of the 40 stores are members of the Hong Kong Tourist Association.

y choose
ything but Kikusui?
e 5000 series incorporates
e most up to date scope
chnology, which not only
nhances performance but
ensures an unbeatable price
to performance ratio. All
5000 series CROs provide as
standard features: Vertical
Triggering Mode, Autotrigger
Level Lock, Variable Hold-Off
and TV trigger coupling,
ensuring ease of use especially
during frustrating measurement
situations.

Announcing KIKUSUI's exclusive CRO offer. Four specially priced models. Proven quality and 2 year warranty. Order Now.



1 **COS-5020TM**
2 Channel
20 MHz Bandwidth
Max. Sensitivity 1mV/Div
$799 (excl. tax)*

2 **COS-5041TM**
2 Channel
40 MHz Bandwidth
Delayed (B) Timebase
$1,258 (excl. tax)*

3 **COS-5060TM**
3 Channel
60 MHz Bandwidth
Delayed (B) Timebase
$1,704 (excl. tax)*

4 **COS-5100TM**
3 Channel
100 MHz Bandwidth
Delayed (B) Timebase
$2,861 (excl. tax)*

***Includes**
- 2 quality switchable probes.
- Full 2 year warranty.
- Made in Japan.

EMONA
INSTRUMENTS

86 Parramatta Rd
Camperdown NSW 2050
Tel (02) 519 3933
Fax (02) 550 1378
CALL FOR LOCAL
DISTRIBUTOR

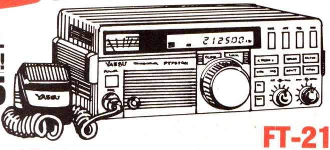
YAESU

Proven Performance

Yaesu's Budget FT747GX:

IDEAL FIRST RIG!

$1395

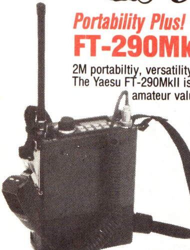


Everything you need without the frills! Yaesu recognised the fact that amateur transceivers were getting out of the reach of the average person. So they did something about it: The FT747GX. A full 100 W with all amateur bands between 1.8 and 30MHz SSB, CW, AM and optional FM; receiver is 100kHz to 29.9999MHz continuous. If you're looking for value along with performance, there's simply not a better rig than the FT747GX; anywhere! Cat D-2930

FT-211RH

45W 2M Mobile Transceiver with mic, mounting bracket. Cat D-3493 **$675**

Plus bonus 5/8 wavelength antenna Cat D-4207 ***(Save $15)***



Portability Plus!

FT-290MkII

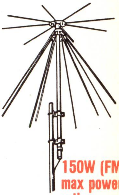
2M portabiltiy, versatility and performance at its best, The Yaesu FT-290MkII is just what you need for real amateur value! Features include All Mode (LSD, USB, CW & FM), 10 memories, 2.5W output, twin VFO's and much more. Cat D-2875

$875

FBA-8 Batt Holder optional Cat D-2876 **$49.95**

FT-690RII also available **$899**

Broad Band VHF/UHF Discone Antenna



Use it for transmitting and receiving! Save $40 on this high quality, Japanese made, broad band discone antenna that covers scanning, 2M, 70cm, UHF CB... the lot. 3dB gain and less than 1.5:1 SWR between 80 & 480MHz! Sensational value at this astounding low price. Cat D-4315

Was $169 Only $129

150W (FM) max power rating

And the ultimate HF/VHF/UHF transceiver: FT767GX

With bonus microphone!

Combine the best features of the renowned FT-757GX with the FT-726 and what do you have? The all band FT767GX. DC to light (well, almost) covering all HF, VHF and UHF bands up to and including 70cm!

Sure, the FT767GX isn't cheap. In any sense of the word! It has all the features and performance you'd want from your amateur station — because it is a complete amateur station — in one! Cat D-2935

Save over $300 off Catalogue price

$4750

- ***Every amateur band between 160m and 70cm!***
- ***A complete amateur station in one handy package!***

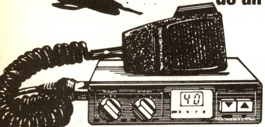
DICK SMITH ELECTRONICS

• **NSW** • **Albury** *21 8399* • **Bankstown Square** *707 4888* • **Blacktown** *671 7722* • **Bondi Junction** *387 1444* • **Campbelltown** *(046)27 2199* • **Chatswood Chase** *411 1955* • **Chullora** *642 8922* • **Gore Hill** *439 5311* • **Gosford** *25 0235* • **Hornsby** *477 6633* • **Liverpool** *600 9888* • **Maitland** *33 7866* • **Miranda** *525 2722* • **Newcastle** *61 1896* • **North Ryde** *88 3855* • **Parramatta** *689 2188* • **Penrith** *(047)32 3400* • **Railway Square** *211 3777* • **Sydney City** *267 9111* • **Tamworth** *66 1711* • **Warringah Mall** *905 0441* • **Wollongong** *28 3800* • **ACT** • **Fyshwick** *80 4944* • **VIC** • **Ballarat** *31 5433* • **Bendigo** *43 0388* • **Box Hill** *890 0699* • **Dandenong** *794 9377* • **East Brighton** *592 2366* • **Essendon** *379 7444* • **Footscray** *689 2055* • **Frankston** *783 9144* • **Geelong** *43 8804* • **Melbourne City** *326 6088* • **Richmond** *428 1614* • **Ringwood** *879 5338* • **Springvale** *547 0522* • **QLD** • **Brisbane City** *229 9377* • **Buranda** *391 6233* • **Cairns** *311 515* • **Chermside** *359 6255* • **Redbank** *288 5599* • **Rockhampton** *27 9644* • **Southport** *32 9863* • **Toowoomba** *38 4300* • **Townsville** *72 5722* • **Underwood** *341 0844* • **SA** • **Adelaide City** *232 1200* • **Beverley** *347 1900* • **St. Marys** *277 8977* • **Elizabeth** *255 6099* • **Enfield** *260 6088* • **WA** • **Cannington** *451 8666* • **Fremantle** *335 9733* • **North Perth** *328 6944* • **Perth City** *481 3261* • **TAS** • **Hobart** *31 0800* • **NT** • **Stuart Park** *81 1977*

ORDER BY PHONE TOLL FREE (008) 22 6610 FOR DSXpress 24 HOUR DESPATCH

A CAN CAN'T

But communications from Dick Smith Electronics let you do all the things you dreamed about when you were a kid.



Reduced to $89

DSE AM CB *SAVE $10!*

Now you get extra value from the amazing DSE AM CB! It's easy to operate and comes with maximum legal power, all 40 channels, microphone, mounting hardware and a great low price to boot. Cat D-1200

Power & Performance!
5W 6 Channel Marine

A hand-held transceiver with all the power and performance of a fixed model! The Uniden AX55 is fitted with all 6 marine channels and you can also use it for CB (just fit the appropriate crystals). A superb transceiver at a bargain price! Cat D-1125

Was $189 Now $169

55 Channel VHF Marine
With Seaphone Compatibility!

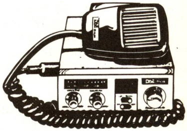
A truly classic transceiver from Uniden - the MC610. Outstanding value and an astounding array of features. With all 55 international frequencies, 1W/25W power saver switch, instant emergency channel 16 selection...it's superb! Cat D-1720

$399

Deluxe AM CB
At A Budget Price!

The compact Maxon AM CB is a favourite among CBer's for quality, reliability and value! With all 40 AM channels, maximum power and superb performance. Complete with mic and mounting hardware. Cat D-1450

Just $99



Extra Range With SSB CB

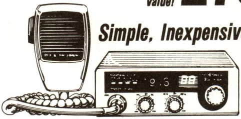
If most of your boating is by the coast - here's the one to buy! The Uniden Barracuda AM/SSB Marine Transceiver with an impressive range of features including 10 AM and 10 USB channels and the one-touch Emergency Channel 88 switch. Cat D-1714

Value! $279

27MHz Marine
Simple, Inexpensive

Sensational value with the ultimate in reliable 27MHz marine! The Sea-Simba is just the thing for the weekend or occasional boater who cares about safety. With 12 channels (10 fitted), mic, mounting hardware, extension speaker, PA jacks and more. Cat D-1718

Exceptional Value! $139.95



DICK SMITH ELECTRONICS

• **NSW** • **Albury** *21 8399* • **Bankstown Square** *707 4888* • **Blacktown** *671 7722* • **Bondi Junction** *387 1444* • **Campbelltown** *(046)27 2199* • **Chatswood Chase** *411 1955* • **Chullora** *642 8922* • **Gore Hill** *439 5311* • **Gosford** *25 0235* • **Hornsby** *477 6633* • **Liverpool** *600 9888* • **Maitland** *33 7866* • **Miranda** *525 2722* • **Newcastle** *61 1896* • **North Ryde** *88 3855* • **Parramatta** *689 2188* • **Penrith** *(047)32 3400* • **Railway Square** *211 3777* • **Sydney City** *267 9111* • **Tamworth** *66 1711* • **Warringah Mall** *905 0441* • **Wollongong** *28 3800* • **ACT** • **Fyshwick** *80 4944* • **VIC** • **Ballarat** *31 5433* • **Bendigo** *43 0388* • **Box Hill** *890 0699* • **Dandenong** *794 9377* • **East Brighton** *592 2366* • **Essendon** *379 7444* • **Footscray** *689 2055* • **Frankston** *783 9144* • **Geelong** *43 8804* • **Melbourne City** *326 6088* • **Richmond** *428 1614* • **Ringwood** *879 5338* • **Springvale** *547 0522* • **QLD** • **Brisbane City** *229 9377* • **Buranda** *391 6233* • **Cairns** *311 515* • **Chermside** *359 6255* • **Redbank** *288 5599* • **Rockhampton** *27 9644* • **Southport** *32 9863* • **Toowoomba** *38 4300* • **Townsville** *72 5722* • **Underwood** *341 0844* • **SA** • **Adelaide City** *232 1200* • **Beverley** *347 1900* • **St. Marys** *277 8977* • **Elizabeth** *255 6099* • **Enfield** *260 6088* • **WA** • **Cannington** *451 8666* • **Fremantle** *335 9733* • **North Perth** *328 6944* • **Perth City** *481 3261* • **TAS** • **Hobart** *31 0800* • **NT** • **Stuart Park** *81 1977*

ORDER BY PHONE TOLL FREE (008) 22 6610 FOR DSXpress 24 HOUR DESPATCH

Looking at the leading edge

Like thousands of others, we just had to have a look at the 'Beyond 2000 Exhibition' when it was presented in Sydney during the first half of December 1988.

by PETER PHILLIPS

The Beyond 2000 Science and Technology Spectrum (to give its full title) was mounted in Sydney during December 88 (3 – 18) and then in Melbourne in February 89 (4 – 17). The publicity for the show was based around the popular TV series 'Beyond 2000', and the exhibition was loosely styled on the format of the show.

The whole display was broken into five sections, to accommodate the number of exhibitors and (for Sydney) was located at the Darling Harbour Exhibition Centre.

I first visited the Electronics section, which turned out to be rather disappointing, considering the relationship electronics is supposed to have to things futuristic.

In this section, Bose had a demonstration, featuring simulated magic and synchronised slides, of its new Acoustimass Speaker system. The demonstration was set up in a small theatre, and the capabilities of the system were presented with great pizzazz. Sound products comprised a few more exhibits, including electronic keyboards, and some automotive sound products.

A popular exhibit within the Electronics section was the Canon display. Here your photo could be taken by what appeared to be a conventional camera, except the picture was actually stored on a small disk inside the camera. Part of the demonstration included taking a volunteer's photo, then 'collaging' it with a suitable background picture and a famous personality. The example created as I watched had a rather ocker individual hugging Maggy Thatcher, against a background of Mount Fujiyama.

However, the real benefit of this technology lies in its ability to transmit colour photos via the phone lines, for subsequent reconstruction by either a colour photocopier or a suitable printer. I was shown a magazine cover that had been done this way, and was unable to tell that it had not been printed directly.

While on the subject of 'phone vision', the US company Image Data Corporation had their Photophone on display. This system is actually for medical purposes and allows X-ray photos to be transmitted over the phone lines, so that a radiologist could perform analysis without the need to travel to the patient's bedside.

Grundig had its latest 95cm (38″) TV on display. The set is called the Monolith, and sells for around the $11,000 mark. It has all the trappings possible, and displayed an excellent and very large picture.

There were other things on display in this section, but I decided to move on to the Lifestyle section. On the way I passed through the Industrial section, where it was obvious that robots were in vogue this year. A most impressive display had been set up by Sydney TAFE, with several robots and automated machinery being demonstrated.

Industrial robots seemed to be everywhere, including one by AEG that was simulating a machining function on a complex metal casting. This robot had several 'work heads' that it could select from a rack, such as a grinder, a reamer, a drill and so on, and the sequence being performed required the use of all of these.

The Lifestyle section had some quite remarkable exhibits. One that attracted me was an ozone water purifier. The developer of this potential winner is the Australian company Klool-Tech (yes, Klool), who have been able to perfect the method despite other countries having decided it can't be done.

The principle is extremely simple – water is mixed with a predetermined amount of ozone prior to filtering though a four micron stainless steel

The Photophone video phone from Image Data. Now being used in the US to transmit X-rays over the phone lines.

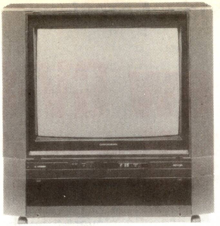
mesh filter. Ozone causes flocculation of any impurities in the water, as well as being certain death to Legionella bacteria, algae and other nasties. Water treated this way is totally pure and makes an excellent drink.

But the lifestyle aspect is as a pool filtering system. Klool-Tech have developed the system into one suitable for backyard pools, and although rather large and expensive ($5000), the system requires no chemicals and is virtually maintenance free. The company claim the pool water will be crystal clear, with a sparkling 'gin-like' finish to it.

While simple in principle, the main difficulty with the development was to get the right ozone/water mix and to make it reliable. However these problems have apparently been overcome, and it's now only a matter of time before the ozone layer gets a bit of a boost and suburbia has odour free sparkling pools.

Solar energy applications were also in evidence, such as pool heating systems, and a solar heating system developed by the University of Sydney.

And for those into true large screen video, the demonstration by Spacevision was impressive. A matrix of 36 TV screens was arranged as a 'video wall' to display a complete picture. The company claims the system can resolve 16 million colour shades and the system can be programmed into various formats to allow some screens to show different displays if required. It's yours for $5000 a day, although a 3 x 3 matrix is cheaper at $1500 a day.



The Grundig Monolith has a screen size of 95cm (38") and includes inbuilt Teletex.

On the subject of things visual, the display by Universal Fibre Optics from Melbourne was a real crowd pleaser. This innovative company has previously featured in *EA* and I was keen to examine at first hand some of their products. Apart from fibre optic devices, a solar powered street sign drew my attention. There were other similarly fascinating devices, including strip lights in the form of a plastic tape that glows when connected to a suitable voltage source. Luminous tape with a half-life of 10,000 hours was also part of the display, along with a rather excellent plasma ball and luminescent house numbers.

Of course there were many other exhibits, ranging from luxury power boats to car polish. The remaining two sections covered medical and defence and I ran out of time to see these. The show certainly demonstrated technology and its possible future effects on our lives.

And it was somewhat refreshing to see a show that put all forms of technology together in the one exhibition. Most exhibits contained electronics somewhere in their workings (except the car polish) but did it so discreetly that the emphasis was on the end result; not the technology. Perhaps the world is getting so used to electronics that it is accepted without mention anymore. But then the show wasn't an electronics exhibition – just a look into the future with the accepted fact that electronics is the key. EA

PERNA
ELECTRONICS

THE Nº1 SOURCE FOR COMPONENTS

MASSIVE SAVINGS ON ARISTA PRODUCTS

Don't pay full price for Arista products from other suppliers. We have discounted the entire range in the new 1988-89 catalogue — over 3000 items!

ORDER VALUE (not inc. P&P)	YOUR DISCOUNT OFF RRP
$25. to $100.00	8%
$100.00 to $500.00	$10%
$500 plus	$12%

This offer strictly applies to our phone and mail order customers only. Don't have a catalogue? Notify us, we will send you one FREE!

THIS OFFER IS LIMITED.

VK POWERMATE 2

BUILD THE NEW UK POWER SUPPLY.
IT DELIVERS A CLEAN, CRISP AND REGULATED 13.8V DG AT A MASSIVE 5 AMPS.
WE SUPPLY THE FULL KIT.
BARGAIN AT $109.00

QUALITY DIODES

PACKS OF 100

IN4004	$4.95
IN5404	$12.95

I C SOCKETS
MACHINE PIN

20 PIN	$1.00
40 PIN	$2.20

WELLER WTCPS SOLDERING STATION

From one of the world's leading manufacturers comes this superb new station. It uses an advanced control system which measures temperature. To change temperature simply change the tip. The ultimate for the professional or the serious hobbyist.
T212000 only $149.50

$50 CREDIT VOUCHER FREE!

YOU RECEIVE A FREE CREDIT VOUCHER WITH EVERY PURCHASE OF A W.T.C.P.S.

I C EXPRESS

Z80 ACPU	$3.50	6502 PROC.	$7.50
74LS04	50¢	MAX 232	$7.50
74LS74	50¢	27128 EPROM	$7.95
74LS123	70¢	6821	$4.95
74LS244	$1.50	XR2211	$7.50
4006	90¢	LM553 4AN	$2.95
4052	$1.20	LM324	65¢
TL071/LF351	75¢	NE555	45¢
V20 8Mhz	$17.95	NE572	$5.95

PERNA ELECTRONICS
Factory 5, 22 Regent Avenue,
Springvale 3171
Mail Orders:
P.O. Box 103, Clayton, 3168
Phone: (03) 562 4079

Exclusive video product preview:

Sony's new GV-8 'Video Walkman'

First they introduced the personal cassette player, then the personal CD player – both of which turned out to be milestones in consumer electronics. Next month they're going to introduce what may well turn out to be a similar 'milestone' product: the personal video/TV player. Here's what we found when we were allowed an exclusive preview of an advance sample.

by JIM ROWE

Just as your 'R & R' bank account was starting to recover after buying that CD Discman (Walkperson?), it's likely to be at risk again from next month. Especially if you're a sucker for the latest technology, and I guess many of us are – even if sometimes we don't like admitting it.

The product that prompts me to make this prediction is Sony's new GV-8 'Video Walkman', which the company is releasing in Australia next month. In a package measuring only 213 x 129 x 67mm and weighing a mere 1.3 kilograms complete with battery and cassette, it combines both a personal colour TV set and a fully functional video cassette recorder.

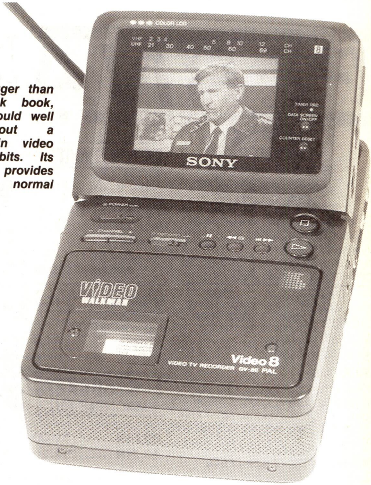
Sony itself seems to see the GV-8 as the first in a new wave of 'personal video' products, and is obviously hoping that it will become a consumer electronics milestone like the company's earlier cassette Walkman and CD Discman products – spawning a whole new market area and matching trend in the way people make use of video entertainment. And having now had the opportunity to try out an advance sample of the PAL version, I think they're probably right.

Video is certainly an integral part of today's range of entertainment choices, and growing in importance all the time, as consumer tastes and expectations become more sophisticated. No longer are many people prepared to choose only from the alternatives provided by TV station programmers, nor are they happy to forego the video medium when they're out of doors, in the car or out on the boat.

We've outgrown the 'broadcast TV' era, in other words, and without a doubt have already entered the broader video era. And if Sony is right, we're about to enter the *personal* video era, where you'll have the chance to watch whatever you want, whenever and wherever you fancy.

But enough philosophising – let's look at the product itself.

First of all, as you you can see it's small. Not as tiny as the personal audio cassette and CD players, to be sure, but really just as impressive when you consider what Sony has managed to cram into that tiny package. It was only a couple of years ago that one or two firms made quite a song and dance about fitting a TV set and a VCR into a



Scarcely bigger than a paperback book, the GV-8 could well bring about a revolution in video viewing habits. Its inbuilt VCR provides all of the normal features.

A peek inside the VCR's cassette mechanism, with the video head drum visible at centre rear.

package about 500 x 330 x 330mm – now Sony has done the same trick in about 1/25th the volume!

To have fitted a complete colour TV receiver and VCR combination in a package the size of large paperback book really is a significant achievement. I suspect it could only have been done using Sony's Video-8 format, with its tiny cassette.

The wonder is that Sony has already developed an even smaller deck mechanism than the one used in the GV-8, for its new range of camcorders. This is 60% smaller and 50% lighter again, so next year there might well be an even smaller Video Walkman Mk2!

Incidentally the GV-8's inbuilt VCR isn't just a player for watching prerecorded video movies. It's a full recorder as well, able to record TV programs for time shifting, or recording home movies using a video camera.

In fact there's a matching very tiny camera available to go with the GV-8, called the CCD-G1. This has a cable and 12-pin plug, mating with a socket provided on the side of the GV-8 and arranged so that the camera derives its power from the recorder.

But if you already have a standard camera, you can use this instead, because the GV-8 has standard video input and video output connectors as well. This also means that the GV-8 can be used as a very compact colour video monitor, and that the video output from the GV-8's recorder can be piped out to a standard large-screen external monitor (or to another recorder, for dubbing).

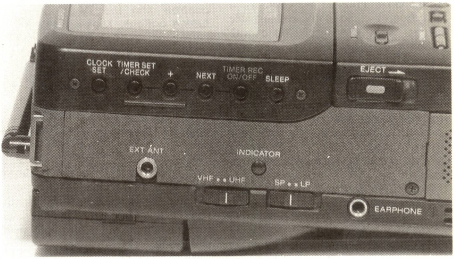
Needless to say it also has matching audio input and output connectors, as well. And there's even a small plug-in RF modulator, allowing the GV-8's output to be fed to a standard TV set. So there's plenty of flexibility.

In some ways even more impressive than the recorder section is the colour TV/monitor section, with its 75mm-diagonal LCD colour screen. This uses the latest active matrix system with thin-film switching transistors (TFTs), and achieves a resolution of 92,160 pixels – significantly better than the first monochrome screens, as well as being in full colour. Built-in fluorescent backlighting provides a level of picture brightness which is very comparable with conventional cathode-ray tubes.

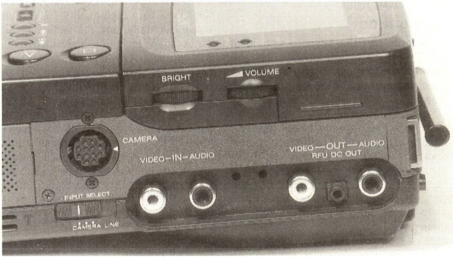
The TV receiver section of the GV-8 covers both the VHF and UHF channels, and unlike earlier 'personal portable' TV sets it features automatic electronic tuning. This means that there's no fiddly dial, fine tuning control or even preset tuning controls – simply two channel buttons marked '+' and '–' plus a small slider switch on the side marked 'VHF-UHF'. You merely select the band you want, and press one or other of the buttons. The receiver then proceeds to search the band concerned, either upwards or downwards in terms of frequency, to find the next active channel.

Just above the top of the screen there are two dial scales marked, one for each band. And as the receiver is searching, a narrow vertical line moves across the screen to indicate the current channel. So the screen itself actually becomes the tuning dial, with the moving line coloured green for the VHF band, and red for the UHF band!

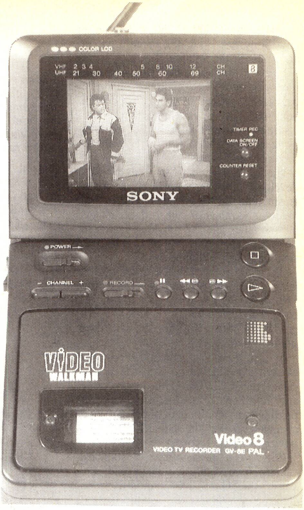
When the receiver finds the next active channel, it automatically locks in at the correct frequency for optimum reception. If you want to be reminded at any time which channel you're watching, you simply press another little button marked 'Indicator', and the tuning indicator line appears briefly on the



Above: A look at the controls and connectors along the left-hand side of the GV-8. The LCD screen tilts up for viewing.



Along the right-hand side are the brightness and volume controls, the camera input (with selector switch) and the video and audio connectors. Note the carrying strap attachment lug, at right.



Another look at the GV-8, showing the colour LCD screen, the VCR deck controls and the TV tuning buttons. These cause the set to scan up or down the band in use, looking for the next active channel. A vertical line appears on the screen during tuning, to indicate the channel - very neat.

screen. It's a very elegant arrangement, and streets ahead of the tuning scheme provided on most personal portables.

Not surprisingly there are the usual brightness and colour saturation controls, plus sound volume. These are all quite small controls, but no problem to adjust when you need to.

Other features of the GV-8 include an electronic counter for the VCR section; a built-in digital clock and timer, able to turn on the recorder automatically at a given time; a switch to select either standard play or long play modes on the VCR; and sockets for both an earphone and an external antenna. In short, all of the facilities you'd expect to find on a full-size colour TV receiver and VCR combination, only much smaller and a mite more elegant.

There are actually four power options for the GV-8. For true 'Walkman' use it runs from a compact 6V rechargeable battery pack, presumably fitted with NiCad cells. The pack is rated at 1000mAh, and as the GV-8 draws a little over 1 amp this means that you can only watch for about an hour using a single fully charged battery pack. For watching a complete movie, you'd need at least two and possibly three charged packs (wouldn't it be nice if battery technology had kept pace with electronics?).

To recharge the battery pack there's a matching charger, which can alternatively be used as an AC power pack by means of an adaptor lead. So extended use is no problem when you have access to a power outlet. There's also an optional dry battery power pack and adaptor lead for powering the GV-8 from a car's cigarette lighter socket.

Trying it out

We only had the advance sample of the GV-8 for a couple of days, but this gave us a reasonable opportunity to try it out in a variety of viewing situations. And frankly we were very impressed.

Probably the thing that impressed us most was the picture brightness and quality. This seems significantly better than any other LCD-screen set we've seen to date, with good viewing over a reasonably broad range of viewing angles. And the picture stands up well in quite high ambient lighting levels, although like most other video gear it doesn't really like full direct sunlight.

The picture resolution is again significantly better than any LCD we've seen to date. Although obviously still not in the same class as a large CRT display, the GV-8's little 3″ picture is surprisingly crisp and detailed, and quite acceptable for personal viewing. There is very little lag or smear, and the 'stair-stepping' effect was really only visible on moving edges.

All in all, a nice little picture, and of course the linearity is excellent – thanks to the inherent digital scanning.

We tried feeding the video output of the GV-8 to a high-quality CRT monitor, incidentally, and the picture quality on both TV reception and video replay was excellent. Obviously the basic video performance of the GV-8's receiver and VCR are more than equal to that of larger conventional units.

We were also very impressed with the performance of the inbuilt TV receiver itself. The automatic scanning tuning and lock-on works very well indeed, and makes the GV-8 as easy to use as a conventional TV set with digital tuning. It's certainly much less frustrating to use than earlier 'personal' TV receivers, although there's still the inevitable fiddling with the telescopic antenna to find the right position.

Despite its compact size the VCR section of the GV-8 seems to provide virtually identical performance to the other Sony Video-8 products, including the standard VCR. This means steady, low noise video and equally clean audio, both of which compare more than favourably with the larger formats.

In short, then, we found the new GV-8 Video Walkman an exciting and impressive product. As Sony hopes, it could easily be the product that catches the imagination of consumers and launches a whole new approach to video entertainment.

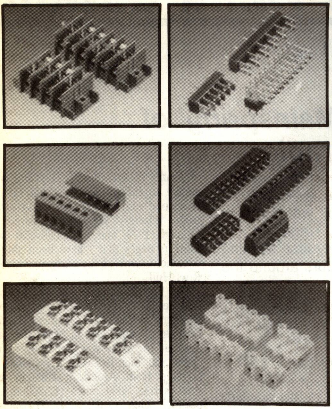
Mind you, this might not happen straight away from next month, because the GV-8 is expected to sell for around $2500. This is complete with battery pack, AC adaptor and charger, folding headphones, connecting cable, antenna/-VCR signal switch and soft carrying case.

It's certainly rather more than a personal audio cassette player or CD player, to be sure. And more than a conventional TV receiver and VCR combination, as well. But the jump in convenience and flexibility is quite dramatic, and opens up all sorts of new possibilities.

It will be very interesting to see what happens when the GV-8 is released on the market next month.

WECO®

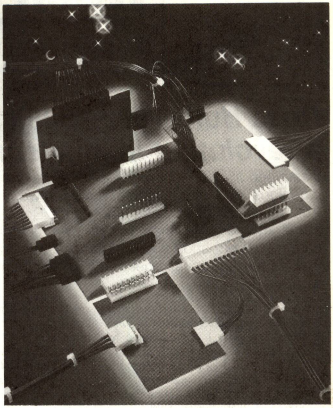
METHODE ELECTRONICS, INC.



TERMINAL BLOCKS

- Printed circuit board mounting
- Plug and socket connectors
- Screwless terminal strips
- Tab type connectors
- Socket terminal strips

QUOTE 6662



TERM-ACON

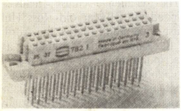
Wire to Board/Board to Board Connectors Methode offer an extensive range of quality Connectors and Headers that are competitively priced to suit your applications

QUOTE 6665

PRINTED CIRCUIT CONNECTORS

DIN41612 Extensive range including heavy duty and coaxial terminations

QUOTE 6663

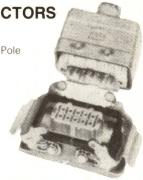


HEAVY DUTY CONNECTORS HAN SERIES

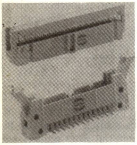
250 VAC/10A 415 VAC/16A to 128 Pole

Terminals available screw, solder, crimp, cage clamp

QUOTE 6666



HARTING®



FLAT CABLE SEK SERIES

Economic Assembly —
Reliable Connections
Extensive Range available
6 to 64 Pin
Standard and low profile
Headers

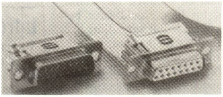
QUOTE 6664

D SUBMINIATURE

QUOTE 6667

Plastic and metal Housings

Broad range available including RS232 Shielded Types.



Adilam Electronics Pty Ltd
Incorporated in Victoria

Melb —	**Telex AA151369** **Tel (03) 846 2511 (4 lines)** **Fax (03) 846 1467**
Syd —	**Tel (02) 529 2277** **Fax (02) 529 5893**
Adel —	**N. S. Electronics (08)46 8531**
Bris —	**St Lucia Electronics (07) 52 7466**
Canb —	**Electronic Comp (062) 80 4654**
Perth —	**Pros'spec Dist (09) 362 5011**

When I Think Back...

by Neville Williams

Ross Hull (1902-1938): 'Mainspring' of a revolution in amateur radio

Described in *QST* magazine in 1938 as 'the most brilliant and ingenious and indefatigable amateur we have ever known', Australian technical writer and editor Ross Hull was more at home in the USA than in his own country. Tragically, his career was cut short when he ignored the 'safety first' warning that he had personally penned for fellow amateurs around the world.

When I first joined the staff of *Radio & Hobbies* (now *Electronics Australia*) in December 1941, I was reminded by the then advertising manager P.A.Morse that I was occupying the chair that, some years previously, had belonged to a remarkable young technical journalist, the late Ross Hull.

The strange thing was that, apart from 'Pop' Morse and Editor John Moyle, who by then had joined the RAAF, very few of those by then still involved in the magazine seemed to know much at all about Ross Hull, the man. They had heard about him, but that's about as far as it went; there was no personal file in the office, not even a picture.

I was puzzled but, in the wartime conditions, the efforts of available staff had to be directed towards coping with the present, rather than delving back into the past.

Now, 50-odd years later, I've been able to piece together the story of an undoubtedly outstanding architect, musician, artist, photographer, writer, amateur astronomer and radio amateur, who opted out of the Australian radio scene but who still contributed to it from half-way around the world.

Ross Hull was born in Melbourne in 1902 and, had he followed the course mapped out for him, would have become an architect – full stop! But, like quite a few others in that era, he was well and truly bitten by the wireless bug. By 1922, at age 20, he had become an active amateur and a member of the select group which, before the commencement of official broadcasting, provided speech and music signals for a growing number of equally enthusiastic listeners.

1923 – a busy year

August 1922 had seen the launch of *Wireless Weekly*, which later gave birth to *Radio & Hobbies* (1939) and ultimately to *Electronics Australia* (1965). A second and rival magazine *Australasian Wireless Review* appeared in January 1923 and, ironically, it was from its pages that I have been able to document some of the early activities of Ross Hull.

A picture of Ross Hull taken in 1929, when he returned to Australia to work on Wireless Weekly. (Courtesy ARRL)

The Feb.'23 issue of the *Review* carried details of Trans-Pacific tests, open to amateurs and experimenters Australia-wide. To be held in May, the purpose of the tests was hopefully to receive and identify as many signals as possible from American amateur stations across 8000 miles (12,800km) of ocean. This was at 200 metres (1500kHz) and using a maximum transmitter power of 1kW.

In Dec.'21, when similar Trans-Atlantic tests appeared to have failed, a listener in Scotland had intercepted and identified similar signals from amateurs on the American east coast. The question now was whether American amateurs centred at Long Beach on the American west coast could bridge the gap to Australia.

The challenge must really have gripped the 21-year old Ross Hull because, two months later, the April issue of the same journal contained a brief description and a picture of a protoype 'breadboard' receiver that Melbourne amateurs R.A.Hull and G.Hiam had designed and produced especially for the tests.

After trying out the Armstrong superregenerative and superheterodyne circuits, said the article, the authors had settled for a 6-valve line-up of tuned

Introducing a new column

This article launches a new regular column by our former Editor-in-Chief, Neville Williams. In the column he'll be dealing with personalities, situations, trends and developments in the history of electronics – often drawing on his extensive personal experience, although ideas and material from readers will be welcome.

radio frequency stages, followed by a detector and two audio stages. This was at a time when most listeners were using a simple regenerative detector, and when they were being implored not to use their receivers during the tests for fear that radiation from oscillating detectors would block out the weak incoming signals.

Speech, music, records

But that was not all. In the same issue, an editorial representative tells of a recent visit to Melbourne, during which he had learned of a group of amateurs who were arranging a nightly schedule of voice transmissions, plus live and recorded music on 440 metres (680kHz) – in the present AM broadcast band.

Active in the group, and responsible for a demonstration broadcast concert was Ross Hull, 3JU, who provided piano solos and accompaniment for a violinist friend, O.H.Narkoi.

The public broadcasts were suspended for the duration of the Trans-Pacific tests, which proved to be both successful and rewarding, as reported in the July and August issues of the *Review*.

Ross Hull was credited with having verified the first of many trans-Pacific contacts, but a follow-up note in the September issue states that a belated confirmation, received through the post from an American amateur, had indicated that the distinction really belonged to Charles Maclurcan (2CM) of Strathfield, Sydney NSW.

That aside, Max Howden, Ross Hull and C.Hiam were considered to be the most successful participants. The November issue of the *Review* indicated that, on one occasion, Ross managed to log 26 American amateurs within the space of one hour.

Another separate news item noted that his station 3JU was the source of a most enjoyable 2-1/2 hour concert provided by the Beaver Club of Essendon. This was some 3 months before 3AR, Melbourne's first broadcast station, opened in January 1924.

One month later, he was reported to have been involved in a series of low-power night-time transmissions from Charles Maclurcan in Sydney, to his own station at St Kilda, Melbourne. Supervised by an independent engineer, the input power to the final stage of 2CM's transmitter was reduced in steps from 7.8W to 0.078W, with all transmissions being copied, on the first (and best) night. A busy man, indeed!

Ross Hull pictured in his amateur radio 'shack' in Melbourne, about 1924. He was then honorary Federal Secretary of the WIA and had the callsign 3JU. (Courtesy ARRL)

From WIA to ARRL

About this time, Nov/Dec '23, public broadcasting stations began to appear on air, leaving amateur stations to concentrate on the techniques and technology of two-way communication, both local and overseas.

Active at first in the Victorian Division of the WIA (Wireless Institute of Australia), Ross Hull later became Honorary Federal Secretary of the organisation and, in that position, developed a mounting interest in amateur activities worldwide.

It was in that frame of mind that he met up with the ARRL (American Radio Relay League) Traffic Manager, Fred Schnell, during the visit to Sydney, in 1925, of the American Battle fleet. At the time, the US Navy had been seeking to evaluate short-wave technology for future communication purposes and, by arrangement, the League's Traffic Manager was in complete control of experimental high-frequency equipment on board the USS Seattle.

There and then, Ross Hull made up his mind that he had to visit the USA and view for himself the American radio scene, particularly in relation to amateur radio and its emerging public service activities. So it was that, in the following year, 1926, he knocked on the door of the ARRL headquarters at West Hartford, Connecticut.

As it happened, the organisation had been looking for someone to fill a junior position in the editorial department handling technical information. Ross Hull sought and was given the position which seemed, at the time, to offer an admirable vantage point from which to view the American scene.

Such were his skills that he was soon re-classified as an assistant editor, and then as Associate Technical Editor of QST magazine. Amongst other tasks, he is credited with having virtually re-written the fourth edition of the ARRL Handbook, published in Dec.'28.

Earlier in that same year, the ARRL Board of Directors had authorised a virtual 'crash' program to devise technology and equipment that amateurs would need to move to the higher frequencies nominated by the Washington Convention. Ross Hull was appointed as director of the new team.

In that position, he quickly set in motion and, to a large degree, personally 'engineered' a virtual revolution in amateur band technology. Ten years later, in November 1938, the ARRL's own magazine *QST* summarised his contributions in the following terms. He had, they said:

- Popularised band-spread for amateur

receivers.

- Been responsible for the first serious use of the superheterodyne in amateur circles as the logical type of receiver for 'phone stations.
- Produced the first practical apparatus employing the high-C circuit for self-excited oscillators.
- Made the first presentations in amateur radio for the use of 100% modulation and the use of linear amplifiers.
- Introduced the signal monitor.
- Encouraged the abandonment of 'breadboard' construction in favour of bent-metal chassis.
- Popularised with amateurs the practice of mounting valves upside down or at odd angles in order to shorten leads.
- Promoted by example good workmanship in home-built amateur band equipment.

Back to Australia

In 1929, after about 2-1/2 years at the ARRL headquarters, the Australian 'visitor' was found to have 'reached the end of his stay' in the USA, making it necessary for him to return to Australia.

Farewelling Ross Hull on the occasion, K.B.Warner, then ARRL Editor and Business Manager emphasised the urgency of the re-equipment program, the "unbelievable number of hours of (personal) effort", and the fact that Ross Hull's "program" articles had been highlights of QST over the past year. "His labours", said KBW, "have answered our difficulties and his articles have set the new 1929 standard in the literature of our hobby".

The ARRL's loss became a potential plus for our own ancestor *Wireless Weekly* when they announced on June 14, 1929, that they had secured the services of Ross A. Hull as Technical Editor – "fresh from America, with new ideas for Australian readers".

His first article in the following issue, 'A Brilliant Future for Australian Broadcasting?' was predictable for someone who had returned from a high-pressure all-amateur situation, to a weekly magazine which was as much concerned with programs and personalities as with technical matters. More than that, to a technical fraternity more interested in broadcast wireless/radio than in calling CQ.

Compared with American broadcasts, he said, Australian radio seemed to be somewhat 'tame and amateurish', although such a reaction ignored the fact that it was for a different community in a different country. By contrast, Australian radio was comparatively free from the interference and confusion of too many stations trying to share a limited band space and be-devilled by intolerable interference and static.

Listeners could be thankful, he said, that they could enjoy the programs with much less pretentious receivers. Experimenters were fortunate, too, in having access to components from the UK, Europe and America, as well as those produced locally.

But a plug-line on the cover of that same issue would not have been unwelcome to the new Technical Editor: 'Further notes on model plane building'. If Ross Hull's prime involvement was in technical radio, numbered high among his other wide-ranging interests was: model planes.

Articles over the next few months covered a mix of wireless 'politics', technical theory and receiver construction.

Interestingly enough, it was Ross Hull who, in Feb.'30 introduced *Wireless Weekly* readers to the time-honoured Loftin-White amplifier, using a type 24A pentode voltage amplifier, direct-coupled to a big, husky type 50 power triode. In doing so, however, he insisted that the name was a misnomer and that the concept pre-dated Loftin and White's adaptation of it.

This picture was taken in 1936, when Ross Hull's brother Galbraith (left) visited the ARRL headquarters in Connecticut.

The circuit was picked up again years later in another Australian publication and triggered a controversy that gave birth to my original 'Let's Buy An Argument' column, later to become 'Forum'.

As it turned out, Ross Hull's contribution to *Wireless Weekly* was short-lived. Within about 18 months, he had completed plans to return to Connecticut – this time officially – vacating his Sydney editorial chair in favour of his brother Galbraith (A.G. Hull).

Back in America

When he rejoined the ARRL, this time as Associate Editor of QST magazine and other League publications, he more or less took up where he had left off, assuming responsibility for production and the technical program, as well as directing his artistic and photographic skills to the presentation of the magazine.

But the laboratory remained as his first love, and his new and consuming interest was communication in the UHF (ultra-high frequency) spectrum, notably in the 56MHz (5 metre) and 112MHz (2-1/2 metre) amateur bands. In an article 'Fun on Five', he emphasised to his readers the pleasure to be gained from relaxed local contacts on UHF – as distinct from the rough-and-tumble of the crowded lower frequency bands.

(These days, that portion of the spectrum from 30-300MHz is defined as VHF – very high frequency – with UHF referring to frequencies in the range 300-3000MHz. The original terminology has been retained in this article to conform with the various references).

Thumbing through contemporary *QST* files, the Feb.'35 issue carried a timely article on stabilising UHF Transmitters. Subtitled 'Resonant short-line frequency control for 2-1/2 and 5-metre oscillators', it adapted for amateur use technology that had been described in the IRE (American Institute of Radio Engineers) *Proceedings* for Nov.'31.

In May of the same year came 'Progress in UHF Gear', introducing the then-new 'acorn' miniature valves.

A glance at the illustrations, with their once-familiar bits and pieces, their vertical metal 'Lecher' bars and the type 800 UHF power triodes, were evidence enough of what amateurs in Australia were picking up and building in the same era.

With mounting evidence that UHF transmissions were not limited to quasi-optical paths (*QST*, Jan.'35) Ross Hull also directed readers' attention to high-gain antenna arrays, which were helping to push the useful range on 56MHz (and later 112MHz) from around 15 to 100 miles or more (24-160km).

A news picture in Feb.'35 showed a 2-bay, 56MHz horizontal antenna array used by W2EKC to bridge the 90 miles (144km) from Long Island into Connecticut, with a 'walloping signal', using a single receiving type 45 power triode.

Propagation research

At about the same time, convinced that amateurs, as a body, could assemble original and meaningful information on the propagation of UHF signals, Ross Hull showed the way by initiating a research program in conjunction with groups at Harvard University and the Massachusetts Institute of Technology.

Using at first a super-regenerative receiver, then a crystal-locked superhet in conjunction with mechanised recording equipment, he was able to demonstrate a behavioural relationship between long-distance UHF signal propagation and atmospheric conditions.

Extending over several years, the work was first announced in October 1934, with a detailed progress report in June '35. Further articles followed in May and July '37. As a member of the IRE, he also delivered a number of lectures on his UHF propagation studies, including major Conventions at Washington and Chicago.

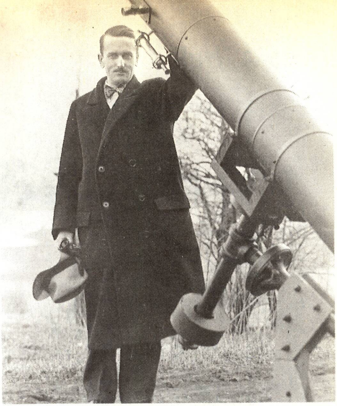
Much of this work is reflected in the 1936 edition of *The Radio Amateurs Handbook*, which I still have in my library. The foreword is signed Ross A.-Hull, Editor, West Hartford, October 1935.

Model planes, TV

Another whole area of activity had to do with radio controlled model planes, already established as an associated hobby by a group of US east-coast amateurs. With interest re-kindled by a visit to a soaring contest at Elmira, New York, Ross Hull introduced his *QST* readers to the idea in Oct.'37.

Long before the days of transistors and miniaturised components, the models had to be large enough to support the weight of valve type equipment and batteries.

Characteristically, before publishing the article, Ross had been through a complete exercise with R.B.Bourne, W1ANA as 'pilot', rebuilding – and re-crashing – a sailplane with a 13ft (3.9m) wingspan and trying out a variety of receivers and control mechanisms. Aiming for better things, they ended up with a 16ft (4.9m) sailplane, preferring the glider configuration to avoid possible interference problems from an ignition system.



Another of Ross Hull's interests was astronomy. Here he is pictured in the USA with a home-made reflecting telescope. (Courtesy Ross Hull Jr.)

But, by then, a new interest had arisen – television. From his home on a Connecticut hilltop, 1000ft (305m) above sea level, and backed by his experience with 56 and 112MHz antenna arrays, Ross was able to receive virtually noise-free signals from the experimental NBC TV transmitter in New York – much to the surprise of NBC engineers.

More than that, he built an experimental amateur television transmitter in the ARRL laboratory which worked well enough to suggest that, one day, amateurs could well become involved with two-way communication using low-cost TV equipment.

Working through all this reference material, the answer to my initial puzzlement became clearly evident. As a young man, Ross Hull's wireless/radio activities had received some publicity in local and technical publications but, having in mind the limited travel facilities of the era, his immediate contacts were mainly in Melbourne.

Upon joining the ARRL on the first occasion, he quickly began to make a name for himself in amateur circles world-wide but, this time, his friends were mainly on the US east coast.

True, he returned to Australia in 1929 but only for as long as it took him to make arrangements to resume his career with the ARRL, with a view to taking up American citizenship.

For our magazine, his 18 months at *Wireless Weekly* was a mere interlude. Then it was back to America and the ARRL, leaving behind a well deserved reputation as a man of many talents but only a limited number of Australian friends, as we became preoccupied with the '30s – the 'golden age' of broadcast radio.

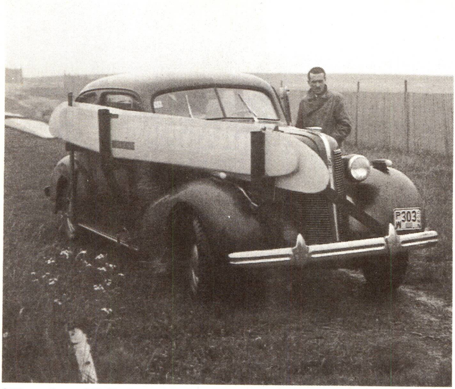
A tragic accident

Sadly, it was Ross Hull's interest in television which ultimately cost him his life.

After the best part of 20 years experience, he was well aware of the danger posed to amateur station builders and operators by the high voltages present in their equipment. He had personally written the bold-type warning on the first page of the chapter dealing with power supply equipment in the aforementioned *1936 ARRL Handbook*: 'DANGER – HIGH VOLTAGE!' (See panel)

Years later, the message had been reinforced by a letter to the Editor from Howard A.Chin, of the engineering department of the Columbia Broadcasting System.

Reacting to a particular picture on the cover of the July '38 issue of *QST*, Howard Chin pointed out that professional transmitting equipment had to be fitted with protective devices and be maintained by formally licenced person-



Still another of Hull's interests was radio control of model aircraft. Here he is pictured about to assemble a model sailplane. (Courtesy ARRL)

nel. By contrast, amateur equipment was not subject to any mandatory safety requirements. The amateur movement would be well advised to put its house in order "before an arbitrary set of rules is promulgated by a regulatory body".

In his reply, Ross Hull tended not to take the matter all that seriously. He had run a fair amount of material on the subject, he said, and his correspondent should perhaps ponder the actual performance of amateurs in this area – strangely inconsistent with the wording of his published warning. However, he conceded that Howard Chin did have a point and suggested that he might like to contribute an article for *QST* about the ways and means of achieving greater safety.

Ross had even worked out a provisional circuit involving a 'curtain' of light-beams which would cut the power if anything entered the hazardous area in amateur equipment. But sadly, with the paperwork still on his office table, he defied the rules in his own home.

Needing 6000V for the kinescope (picture tube) in his experimental television receiver, and bugged by surface leakage in low current EHT transformers, he had installed an EHT supply on a shelf under the bench, using a 4400V, 1-1/2kW pole transformer. It was a brutal supply to have in any hobby workshop but, while it was ostensibly tucked out of the way under bench, the mains outlet was under the same bench – on the wall immediately above and behind the transformer.

On the evening of September 13, 1938, with the idea of showing a doctor friend the NBC TV transmissions, he slipped on a pair of headphones, and reached under the bench to turn on the equipment. As he withdrew his hand, he touched the 4400V lead connecting to the rectifier top-cap, dragging it with him as he fell.

The doctor rushed to his aid, but death had been instantaneous. A brilliant technical and jounalistic career had been cut short at age 36.

Final tribute

In his final tribute in *QST* for Nov.'38, K.B.Warner said:

"For over ten years, his name has been representative of the best and newest that radio offered the amateur. Our loss is the world's loss because not every generation produces a Ross Hull, and a man of his genius and drive was certain to make even greater contributions to the world's progress, had he been spared. His memory and example must be a source of constant inspiration to amateurs in the years to come... He was a grand guy."

DANGER – HIGH VOLTAGE!

It must be realised that the plate supply equipment of even a low-powered transmitter is a potential lethal machine. It is ever ready to deal out sudden death to the careless operator. A number of amateurs, indeed, have been killed by the output of their power supplies during the past few years. Many more have suffered severe injury. We cannot urge too strongly the observance of complete care in the handling of power supplies and transmitters.

The safety warning which was printed in the 1936 edition the ARRL Handbook, apparently written by Ross Hull himself.

INTRODUCING:
THE ULTIMATE COMMUNICATIONS INTERFACE CARD
For IBM® PC, XT & AT & COMPATIBLES

THE EC-452 — $129 + tax
KIT EC-452-SK — $99 + tax
SUPPORT YOUR MOUSE, MODEM AND PRINTER ON ONE CARD!
Ideal for applications requiring Multiple Printers.
Highly Reliable. Fully Socketed.
As featured in Electronics Australia May 88.
ORDER YOUR FIRST CARD TODAY

Suitable for Machines Running up to 16 MHZ.
25 Pin SERIAL PORT
9 Pin SERIAL PORT
25 Pin PARALLEL PORT
All Mounting Hardware
Comprehensive User Manual

KEN CURRY
Managing Director

26 Boron Street,
Sumner Park, Brisbane
Qld, Australia, 4074
Fax: (07) 376 3286

BRISBANE —
(07) 376 2955
WELLINGTON — N.Z.
(04) 85 8742

energy CONTROL

Z-PRO Emulators

xperience quick delivery,
asy operation, fast develop-
ent schedules. EZ-PRO®
sers reap the benefits of the
language fully integrated
ith advanced emulation
ols, including precedence
iggering, Deep Trace,™
n-line code revisions, and
erformance analysis tools.
In addition to IBM® PC-XT/
T, hosts include IBM Personal System/2,™ Macintosh II,™ VAX,™ MicroVAX,™ and Sun Workstation.®

EZ-PRO users also have the advantage of the best post-sales support in the industry.

They know that their emulators are covered by American Automation's 5-year limited warranty.

Experience counts. Now with over 10 years experience, American Automation has designed more emulators than anyone. Count on EZ-PRO to provide the most cost/effective development support.

Intel:		**Motorola:**		**Hitachi:**	**Rockwell:**	**RCA:**	**Zilog:**
	8031		6800	6301R	6502	1802	Z80A
	8032		68B00	6301V1	6503	1805	Z80B
8086	8035	68HC11A2	6801	6301X	6504	1806	Z80H
8088	8039	68HC11A8	6802	6301Y	6505	CDP6805C4	Z180
80186	8344		68B02	6303R	6506	CDP6805C8	Z8001
80188	8048	68000	146805E2	6305V	6507	CDP6805D2	Z8002
80286	8049	68008	6803	63705	6512	CDP6805E3	
	8050	68010	6808	6309	6513	**Harris:** 80C86	**NEC:** V20 V40
	8051		68B08	6309E	6514	80C88	V30 V50
	8085A		6809	64180R0	6515	**National:**	**Signetics:** 8X300
	8085A2		6809E	64180R1		NSC800	8X305
	8096/97		68B09				
			68B09E				

...AND MORE

***Assumes EZ-PRO Development Station connected to MSDOS host.**

For a free demonstration call

KENELEC PTY LTD
(Incorporated in Victoria)

48 Henderson Road,
Clayton, Victoria 3168.
Ph: (03) 560 1011
Fax: (03) 560 1804
Tlx: AA35703

● NSW (02) 439 5500 ● SA (08) 223 2055 ● QLD (07) 393 0311 ● WA (09) 322 4542

IBM is a registered trademark of International Business Machines, VAX and MicroVAX are registered trademarks of Digital Equipment Corporation, Macintosh is a registered trademark of Apple Computer, Inc., Sun Workstation is a registered trademark of Sun Microsystems, Inc.

DICK SMITH ELECTRONICS DICK SMITH ELECTRONICS DICK SMITH ELECTRONICS DICK SMITH ELECTRONIC

ALL YOUR ELECTRICIANS' REQUIREMENTS . .

Just in case you hadn't noticed(!) over the past few months we've greatly increased our range of Electricians' and Contractors' requirements: cables, outlets, boxes, etc etc.

Now you can get your bits and pieces at the same place you get your bits and pieces!

JUST A SMALL SELECTION

Cables

Twin & Earth - Light

1/1.13 conductors in red and black insulation, with earth wire, for general purpose lighting circuit usage. Rated at 10A. Cat W-2060

$1.25/m or $95/100m roll

Twin & Earth - Power

Heavier 1/1.78 conductors for general purpose power circuit usage. Twin insulated conductors plus earth, rated at 25A. Cat W-2062

$1.95/m or $175/100m roll

Twin Flat

$1.40/m or $125/100m roll

Multistrand cable consisting of 7/0.50 conductors, in insulated flat format with no earth. Rated at 15A. Cat W-2061

Twin Flat "Switch" Cable

1/1.13 cable (rated at 10A) with red and white insulation (not red and black) for use in switch wiring (ie ceiling rose down to switch, etc). White cable avoids mix-up of neutral and switched wires. Cat W- 2063

$1.10/m or $90/100m roll

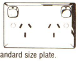
Insulated Earth Cable

Standard 7/0.67 copper earth wire, with green/yellow insulation. For all general purpose earth wire usage (also makes a great aerial wire for radio use!) Cat W-3010

70c/m or $60/100m roll

Switches, Outlets, Etc:

Dual GPO:



Twin switched general purpose outlets on one standard size plate. As used e-v-e-r-y w-h-e-r-e! Cat P-5560 **$12.95**

Wall Board Clips

$1.50

Ideal for "later on" fitting of points, switches, etc to existing plaster walls. Mounts from the front, power po etc actually grips t wall. Cat P-5530

Single Light Switch

Standard architrave mount light switch, SPDT with looping terminal, rated at 10A. (While they last - we're shortly changing to individual switch blocks & plates) Cat P-5570

$4.95

Mounting Block

Suits standard size outlets, switch plate etc - perfect for mounting proud of w or other surface wh inset mounting cann be achieved (eg brick!) Cat P-553

$2.75

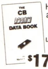
Don't forget: we also have a great range of mains plugs & sockets, fittings, etc for flexible cords. AND the flexible cord!

A BIT OF HEAVY READING!

Not a lightweight, this one: the new 15th edition Antenna Handbook, from the ARRL. Internationally known as one of the best references you can get on antennas. Update Now! Cat B-2208

$39.95

CB EPROM Data Book



THE CB EPROM DATA BOOK

Hundreds of mods, adaptions, tips etc to get the most from the EPROMs used in most CB's. If you're into CB: get into this! Cat B-2329

$17.95

Radio Theory Handbook

A great one for the Aussie amateur - Ideal reference work for getting that elusive amateur licence! Cat B-4002

$39.95

$10 OFF TOROIDALS

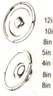
What low noise, high capacity and small size in a transformer? You want a toroidal. And if you want a ten dollar saving, you want this one! 35/35V @ 2.2A plus two 15V windings. Ideal for audio amplifiers. Cat M-1602

Was $69.95

NOW $59.95

$5 OFF MAGNAVOX

YES! A big five dollars off every Magnavox this month only - regardless of size! Be quick to grab some for replacements, building new systems ...whatever!



		WAS	NOW
12in WOOFER (12W)	C-2050	$54.95	$49.95
10in WOOFER (6J)	C-2052	$44.95	$39.95
8in WOOFER (8W)	C-2054	$34.95	$29.95
5in MIDRANGE (RM120)	C-2060	$16.95	$11.95
4in MIDRANGE (C10M21)	C-2062	$14.95	$9.95
8in TWINCONE (8AX020)	C-2080	$24.95	$19.95
8in TWIN VOICE (8JX)	C-2082	$29.95	$24.95

UTILUX: THE MULTI-WAY CONNECTOR

Got some connections to make? Make'em safe and sure with the multi-pin connectors. As used i computers, automotive industry Space Shuttles . . . they're everywhere! Assemble-it-yourse system, plug is captive to socke unless released. Your choice of pins, too:

2-WAY Cat P-5102 **$1.75 ea**

3-WAY Cat P-5103 **$2.25 ea**

4-WAY Cat P-5104 **$2.50 ea**

6-WAY Cat P-5106 **$2.95 ea**

12-WAY Cat P-5112 **$3.95 ea**

"Universal" Panel Meters

Here's a great idea for anyone involved in design, building, repairing or servicing electronic equipment. Now you don't need to keep a range of meters on hand: just one of each size! Our "Universal" packs are just that - with the shunts and multipliers included, you can make just about any standard meter in seconds. And the scale is also "universal" - just label it with the units you want! Saves a fortune - and you've always got the meter you want!

100uA MU45 Universal Movement

Standard 55 x 52mm meter with 55 x 30mm scale. Cat Q-2045 **$14.95 ea**

100uA MU65 Universal Movement

Larger 96 x 82mm movement, 96 x 49mm scale. Cat Q-2065 **$19.95 ea**

Universal Meter Shunt Pack

Just add the shunt or multiplier you want to make the meter you want. Includes instructions. Cat Q-2046 **$1.50 pk**

80 to 480MHz IN ONE ANTENNA!

Our discone antenna is perfect for the amateur, VHF listener or scanner enthusiast. High performance, low SWR - and up to 250W rated. Cat D-4315

$129

Mobile Scanner Antenna

Get more from your scanner than those little whips can give you! Mobile antenna fits all standard bases, covers 70 to 525MHz (receive only). A must for the real scanner enthusiast or professional listener. Cat D-4434

$14.95

Economy Broadbander

Base scanner antenna that won't break the budget. 65 to 520MHz coverage at less than $50 - it's a bargain! Cat D-4432

$49.95

IT'S A GAS!

Butane Powered Tools mean you can go anywhere!

Portasol:

The original and best non-electric iron. Equivalent to a 60W iron, takes standard cig lighter butane and recharges in seconds. Cat T-1370

$39.95

Blowtorch:

Silver soldering & brazing wherever you want. Or even decorative woodwork, etc. Tiny, easy to use - and works brilliantly. Try one - tell us if we're wrong! Cat T-1380

$14.95

Butane Gas:

Pressurised tin of Butane gas to refill your Portasol or Blowtorch. With appropriate nozzles. Cat N-1081

$2.95

MARINE RADIOS . . . SAVE!

Save money by buying at Dick Smith Electronics. Save worry by knowing you're protected. And, quite possibly, save a life!

MC610 VHF Seaphone Approved

The ultimate for close in-shore boating. VHF has 55 channels, is reliable and normally monitored 24 hours a day! AND you can make phone calls direct from your boat. Fit one to your boat before you go out again! Cat D-1720

$399

Antenna to suit: Specially designed for VHF Marine Band. Includes deluxe base. Cat D-4014 **$49.95**

Economy 27MHz

12 channel AM Sea Simba marine radio - if you can afford to run a boat, you cannot afford NOT to run one of these. Maximum legal power. Cat D-1718

$139.50

Antenna to suit: 175cm whip with base, suits non-metal boats. Cat D-4069 **$49.95**

$3 OFF SUPPRESSORS

Standard 3-pin mains plug tops, with inbuilt capacitors for mains spike suppression. Use wherever mains spikes are a problem - on appliance generating spikes, or o appliance to be protected. Simply replaces existing plug. Cat P-5425

WAS $8.95

THIS MONTH:

$5.95

MORE TEST GEAR!

Audio & RF Generators

They're back! Our famous audio & RF sig gens are back after some time being out of production.

$229

RF Generator

- 100kHz to 150MHz/6 ranges
- 3% Accuracy
- Sine and Square Wave Output

Cat Q-1312

AF Generator

- 10Hz to 1MHz/6 ranges
- <0.5% distortion
- 240V operated

Cat Q-1310

$249

Wanna Dippa?

Our Transistor Dip Meter is ideal for the ham shack, test bench or lab, and has a 1.5 to 250MHz range with 6 colour coded plug-in coils. Essential test gear! Cat Q-1335

$139

Lux Meter

No - it's not for soap flakes. Direct read-out of light level from 0 to 50,000 lux. Now you can argue with the umpire at the cricket when they walk off! Why pay twice as much? Cat Q-1400

$129

TIME TO FIX THE TV ANTENNA INSTALLATION???

Everyone knows Dick Smith Electronics is the place to go for your new TV antenna. But what about the bits and pieces? The plugs & sockets? The splitters? The wall outlets? The cable? And everything else in the TV field? Here are just a few to whet your appetites!

75 OHM (CO-AX) TYPE

Metal 75 Ohm Line Socket

Great for extensions & vcr's. Cat P-2030

$1.80 ea

Male/Female Coax Joiner

When you need a sex change! Cat P-2070

$1.40 ea

Metal 75 Ohm Line Plug

As above, but the other end! Cat P-2020

$1.80 ea

Coax Cable Joiner

Guess what this is for? Cat P-2075

$1.40 ea

WALL OUTLET PLATES

"Snap in" System - buy the wall or architrave plate you want, and snap in the outlet insert required - 75 ohm, 300 ohm or even "F" (professional) type!

Large Wall Plate (same size as power point). Cat P- 2050 **$2.50**

Small Architrave Plate (Same size as light switch) Cat P-2052 **$1.75**

Inserts:

300 Ohm	75 Ohm	"F" Type
Cat P-2056	Cat P-2055	Cat P-2058
$2.50	$2.50	

300 OHM (RIBBON) TYP

Skirting Board type 300 Ohm outlet. Cat P-2081 **$1.95**

300 Ohm Cable Joiner (plug and socket system, solderless) Cat P-2086 **$1.95**

300 Ohm Plug to suit above - crimp type. Cat P-2082 **$1.20**

300 Ohm Plug to suit above - solderless typ Cat P-2084 **$1.50**

COAX CABLE W-2081 **75c /m**

300 OHM RIBBON W-2070 **30c/**

Now available at 60 stores:

• **NSW** • **Albury** *21 8399* • **Bankstown Square** *707 4888* • **Blacktown** *671 7722* • **Bondi Junction** *387 1444* • **Campbelltown** *(046)27 2199* • **Chatswood Chase** *411 1955* • **Chullora** *642 8922* • **Gore Hill** *439 5311* • **Gosford** *25 0235* • **Hornsby** *477 6633* • **Liverpool** *600 9888* • **Maitland** *33 7866* • **Miranda** *525 2722* • **Newcastle** *61 1896* • **North Ryde** *88 3855* • **Parramatta** *689 2188* • **Penrith** *(047)32 3400* • **Railway Square** *211 3777* • **Sydney City** *267 9111* • **Tamworth** *66 1711* • **Warringah Mall** *905 0441* • **Wollongong** *28 3800* • **ACT** • **Fyshwick** *80 4944* • **VIC** • **Ballarat** *31 5433* • **Bendigo** *43 0388* • **Box Hill** *890 0699* • **Dandenong** *794 9377* • **East Brighton** *592 2366* • **Essendon** *379 7444* • **Footscray** *689 2055* • **Frankston** *783 9144* • **Geelong** *43 8804* • **Melbourne City** *326 6088* • **Richmond** *428 1614* • **Ringwood** *879 5338* • **Springvale** *547 0522* • **QLD** • **Brisbane City** *229 9377* • **Cairns** *311 515* • **Chermside** *359 6255* • **Redbank** *288 5599* • **Rockhampton** *27 9644* • **Southport** *32 9863* • **Toowoomba** *38 4300* • **Townsville** *72 5722* • **Underwood** *341 0844* • **SA** • **Adelaide City** *223 4122* • **Beverley** *347 1900* • **St. Marys** *277 8977* • **Elizabeth** *255 6099* • **Enfield** *260 6088* • **WA** • **Cannington** *451 8666* • **Fremantle** *335 9733* • **North Perth** *328 6944* • **Perth City** *481 3261* • **TAS** • **Hobart** *31 0800* • **NT** • **Stuart Park** *81 1977*

DSXPRESS
DICK SMITH ELECTRONICS EXPRESS ORDER SERVICE
STD FREE
(008) 22 6610
(SYDNEY AREA (02) CALL 888 2105)

NOW AVAILABLE AT ALL STORES — OR CALL
TOLL FREE: (008) 22 6610
FOR HOME DELIVERY!

DICK SMITH ELECTRONICS DICK SMITH ELECTRONICS DICK SMITH ELECTRONICS DICK SMITH ELECTRONICS

SMITH ELECTRONICS DICK SMITH ELECTRONICS DICK SMITH ELECTRONICS DICK SMITH ELECTRONICS DIC
NICS DICK SMITH ELECTRONICS DICK SMITH ELECTRONICS DICK SMITH ELECTRONICS DICK SMITH ELECTR

Our range of DATAK products has proved enormously successful: small wonder, this quality product, made in the USA, makes virtually every aspect of PCB making a breeze. Below are just some of the DATAK products – try them!

ch Resist Pen

ember the pen we used to
? We stopped selling it
n we found out the resist
a deadly poison (others
sell it!). The DATAK etch
st pen is a non-nasty,
ly effective way to make
-off PCB's. Cat N-5180

$4.95

atak urnishing ool:

'll need one of these if
're at all serious about
king PCB's. Cat N-5715

10.95

atak Circuit ix It Kit:

entually, you'll get a PCB
t's RS. Fix it with Cricuit Fix
. Pure Copper traces &
nuts with adhesive backing,
ady to repair a PCB or
dify a new one. Great for
velopers too. Cat N-5900

62.95

Dry Transfers

DATAK make some great transfers. To whet your appetite (no, Lucretia, you don't eat them) here are two.

SAMPLER ASSORTMENT,

containing 17 different sheets. A great starter pack. Cat N-5766 **$19.95**

TARGETS & REGISTERS,

containing 40 different pcb & crosshair registration marks for precision alignment. Cat N-5820 **$7.95**

UNIVERSAL DIL PATTERNS,

allowing you to make any DIL pattern up to 40 leads. 48 in pack. Cat N-5768 **$14.95**

Datak Contact Frame:

Save $6

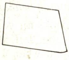
Yep, you'll need one of these too. If you're serious, that is. Beats the old sheet'o glass and two books routine anytime. Cat N-5710

$35.95

Resist These Bargains? Unlikely!

ATAK quality resist products to make your PCB making a reeze. They're also refills for the DATAK PCB kit

eveloper	Resist	Filter
-5905	N-5907	N-5711
11.95	$18.95	$10.95



Pos/Neg Film Refills

hoto-sensitive polyester film
uitable for laying out PCB
atterns in pos or neg format.
sheets 125 × 150mm.
at N-5705

18.95

Film Processing Chemical Pack

Film developer and fixer pos/neg film, or for replacement pack for PCB kit. Cat N-5909

$11.00

DATAK

PCB designing and making material – exclusive to Dick Smith Electronics.

You've asked for them: an economic range of tapes, pads, lettering and so on for designing PCB patterns, marking panels and so on. Here they are!

TITLES, LABELS, NUMBERS, ETC:

A great range of wording ready for your front panel or other marking applications. Dry transfer lettering: simply rub over them with a suitable burnisher (such as a ball point pen).

Audio, TV & Hi Fi

Five sheets containing titles for the above applications plus one letter/number sheet. Available in Black (Cat N-5753) or White (Cat N-5754)

Amateur Radio & TV

Similar to above, five sheets to pack, with letter/number sheet. Black (Cat N-5755) White (Cat N-5756)

Test & Industrial Equipment

Completing the set: 5 sheets for CRO's, meters, analysers, etc etc. Also includes letter/number sheet. Black (Cat N-5757) White (Cat N-5758)

ALL ABOVE SETS: **$8.95**

DIAL MARKINGS, SCALES, PATTERNS, PANEL & METER

Marks & Switch Patterns

Three sheets of assorted arrows, lines, switch graduations, numbers, etc in both Black and White. Cat N-5750 **$11.95 set**

Meter Dial Markings

Four sheets with dial plate arcs & graduations to let you customise any meter movement. Suits meter radii from 25 to 125mm. Black only. Cat N-5752 **$14.50 set**

PCB Making Materials

Datak precision tapes, pads and donuts perfect for commercial as well as hobbyist pcb pattern preparation.

Available in various sizes as listed:

TAPES – precision slit highly flexible crepe.

.031in (N-5780) .080in (N-5786)
.040in (N-5782) .093in (N-5788)
.062in (N-5784) .125in (N-5790)

ALL ONE PRICE: **$3.95 ea**

DONUTS – precision cut donuts to accurately match tape. 380 donuts in each pack, all .031in OD on 0.2in × 0.3in centres

.080in OD – N-5770
.100in OD – N-5772
.125in OD – N-5774
.150in OD – N-5776

All one price: **$4.25 pack**

PATTERNS – Various styles suit most applications.

TO-18 Pattern (3 pin), 144 in set. Cat N-5760
TO-3 Patern (3 pin), 84 in set. Cat N-5762
16 Pin DIL pack, 32 in set Cat N-5764
16 Pin DIL pack, narrow pads. 32 in set Cat N-5765

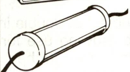
All one Price: **$4.25 pack**

THE BEST OF '88!

Hands-Free Phone

You could spend hundreds of dollars on a hands-free phone. Or you could build this kit. Simple, effective — and cheap! Use in conjunction with existing phone for full two-way hands-free conversation. Cat K-3100

$89.95

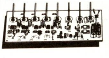


Masthead Amplifier

Crook TV signal? Build your own masthead amplifier and fix it! Very simple to build comes complete with all hardware, power supply, etc. Easy one night project. Cat K-5800

NOTE: Power supply not included.

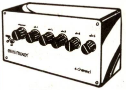
$49.95



Mixer/Preamp Module

Perfect for band use — or any general purpose mixing application. 4 inputs allow virtually unlimited choices: guitar, mic, organ, line inputs, etc, with each input fully adjustable for gain and impedence. Also includes bass, treble and "presence" control. Drives any of above amplfiier modules directly, and uses same power spply. Cat K-3036

$52.45



Mini Mixer

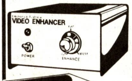
Here's a great beginners project — with specs that make it good enough for serious use. 4 input mixer suits mics, guitar, etc — very simple to make. Cat K-3009

$29.95

Discolight

Move over, Musicolor: Discolite is here. It's the latest in colour organs, with chaser, audio chaser, etc etc. You want a light show? Discolite is what you want! Cat K-3150

$165



Video Enhancer

If the sound of your VCR is crook what about the video! Especially when you're making copies of tapes (yes, the ones you shot yourself of course).Make sure you don't lose detail when dubbing: use the EA video enhancer. Very simple to use: all control is via one knob. And unlike most enhancers, you can cut as well as boost (ideal for softening harsh pictures). Cat K-3463

$49.95

Variable Power Supply: 30V/1A

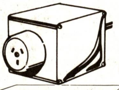
Ideal for laboratory, amateur/experimenter or technician use. Adjustable up to 30 volts at up to 1A — very handy! Includes full metering and overload protection. Cat K-3475

$99

10-150 Watt Speaker Protection Relay

The do-it-yourself speaker protection kit! A universal amplifier monitor/speaker protection device which can be used as a stand alone system with its own power supply or can be powered from the amplifier's own power supply. The system has a delay to eliminate 'thumping' with power-up, detects DC offset levels from output stage, features hold-off delay after fault detection, can be used as a clipping detector, can be preset to indicate when maximum power level is reached and more! Cat K-4008

$37.95



Line Filter/Conditioner

Commercial line filters cost a fortune: build your own for a lot less. Filters out HF noise, spikes, etc and gives over-voltage protection. Cat K-3080

$39.95

$299

1GHz DFM for under $300: complete!

Yes it's true. A 1GHz (that's 1000MHz just in case!) digital frequency counter with typical sensitivity of around 20mV — and even more, it's delightfully simple to build! Cat K-3437

AJOR DICK SMITH ELECTRONICS AUTHORISED STOCKISTS:

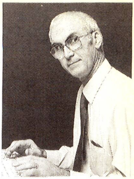
SW • **Armidale**: Sound Components 72 4981 • **Ballina**: Ballina Electronics 86 7022 • **Bowral**: F.R.H. Electrical 61 1861 oken Hill: Hobbies & Electronics 88 4098 • **Charlestown**: Newtronics 43 9600 • **Coffs Harbour**: Coffs Harbour Electronics 52 5684 bbo: Chris's Hi-Fi 82 8711 • **Forster**: Forster Village Electronics 54 5006 • **Glen Innes**: John Sommerlad Electronics 32 3661 ffith: Miatronics 62 4534 • **Inverell**: Lyn Willing Electronics 22 1821 • **Lismore**: Decro 21 4137 • **Moree**: Moree Electronics 52 3458 dgee: Headware 72 3895 • **Nowra**: Nowra Electronics 21 4979 • **Wagga**: Phillips Electronics 21 6558 • **VIC** • **Morwell**: Morwell tronics 34 6133 • **Shepparton**: Phillips Electronics Pty. Ltd. 21 9497 • **Warrnambool**: Marrtronics 62 9870 • **QLD** • **Bundaberg**: Bob n Electronics 72 1785 • **Kingaroy**: Holmes Today Electronics 62 1658 • **Kawana**: Splitec 94 7349 • **Mackay**: Stevens Electronics 723 • **Maryborough**: Keller Electronics 21 4559 • **SA** • **Mt Gambier**: Hutchessons Communications Centre 25 0400 • **WA** • **Albany**: Micro tronics 41 2077 • **Geraldton**: Batavia Lighting & Electrical 23 1842 • **Karratha**: Dave's Oscitronics 85 4836 • **TAS** • **Devonport**: Electronics & Hobbies 24 8322

DICK SMITH
ELECTRONICS

SMITH ELECTRONICS DICK SMITHELECTRONICS DICK SMITH ELECTRONICS DICK SMITH ELECTRONICS DICK

FORUM

Conducted by Jim Rowe



When 'double insulated' very definitely DOESN'T mean safer!

About a year ago, I raised the subject of double insulation and the problems associated with its growing use for many items of audio equipment. This month two further letters have turned up on the same subject, one showing quite clearly that in practice the much-vaunted 'greater safety' of double-insulated gear can all too easily amount to naught.

If you remember, I initially raised the subject not from the point of view of safety, but performance. It's all too easy nowadays to end up with a complete system formed entirely from double-insulated equipment, and for the performance of such a system to be degraded quite significantly because the signal circuitry 'floats' at some indeterminate AC voltage above earth. This is due largely to the effects of stray capacitance from the incoming mains wiring.

In the fairly lively discussion which followed my first column on this subject, most readers seemed to have no great trouble accepting that the performance of a system made up of double-insulated equipment could be degraded. Where everyone seemed to differ was in terms of the correct way (or ways) to solve the problem. And no-one really seemed to be able to explain exactly *why* the safety authorities frowned on what at first sight seemed the simplest and most logical solution: to simply connect the system's signal common to earth!

Well, one of the two letters that turned up this month to revive the subject seeks to answer that very question. It was from Mr Jeff Richards, of West Ryde NSW, and I think the best thing is to reproduce it in full:

I must apologise for the delay in writing, but I really believed the point I had to make was so obvious that it would soon appear, making a letter from me unnecessary. But it hasn't, so here is the letter.

You have expressed puzzlement over a standard for double insulated devices that does not prevent the provision of a 'common earth' connection, nor make it illegal to wire such a connector through to other 'earth' connections, and perhaps eventually to the supply earth. You have claimed, correctly I believe, that provision and use of such a common earth may contribute to the performance and the safety of such a device. The concern is over the part of the standard that requires a double-insulated device to be supplied without any such connector wired through to the mains plug.

You ask, not surprisingly, that if it is illegal to market a 'double insulated' product with an earth lead and a 3-pin plug, why is it also not illegal to connect the 'common earth' of such a device to the mains earth? And if, in fact, such an action is not dangerous, and may actually improve the performance of the product, why is it illegal to supply it already wired in that form?

It seems to me that the answer does not lie in any technical questions of either safety or performance, but in the legal obligations that the standards association wants to impose on the manufacturer.

Put simply, if a consumer should be injured while using a double insulated device with no earth connections at all, there must be nothing in the design, manufacture, packaging, labelling or operating instructions of the unit to suggest that this lack of a safety earth may have contributed to the accident. To have a product qualify as double insulated, the manufacturer must be willing to stand by the safety of the device when operated unearthed, and there must be nothing that may permit him to claim 'improper operation' when it is so used.

Of course, this requirement is in addition to meeting the specific technical requirements of the standard.

All this notwithstanding, if the manufacturer wants to supply a 'common point' for linking to other units for performance considerations, he is free to do so. But he must be careful about suggesting that is a 'safety' connection, or that it has anything to do with the earth lead of a 3-pin plug. hence the somewhat confused labelling and instructions that you found.

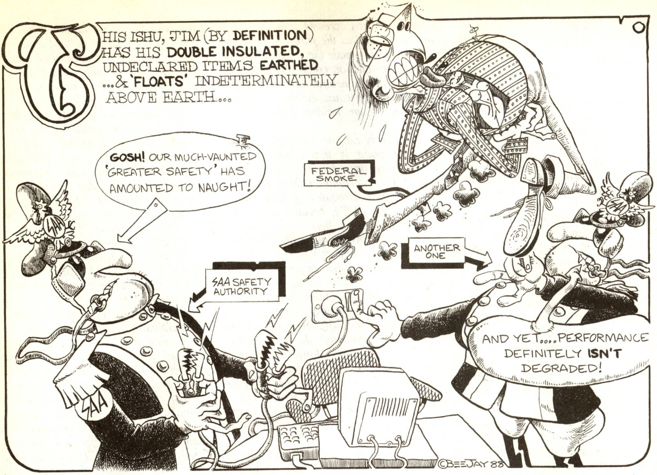
The fact that the 'common point' may actually be a ground, and that tying it to mains ground may improve the safety of the device, is irrelevant.

However the restriction on explicitly using the common point as part of the protection system of the device has caused many manufacturers to omit it altogether – they believe that the mere provision of such a point implies a recommendation on using it as described, and therefore breaches the standard. There may be other circumstances where it is impossible to provide such a facility without appearing to compromise the integrity of other protection systems.

When viewed in this light, the requirement of the standard makes sense, and the variability in practice is explained. It is surprising that the explanation was not offered immediately. Perhaps the bureaucrats don't entirely understand the reasoning behind their own rules.

Thanks for your attempt to clarify the situation, Jeff. But I hope you won't be insulted when I confess that I for one still find it mightily confusing – perhaps some of that smoke from the Federal fire did get in and addle my brain, as Mr Talbot suggested last month!

I think I get the basic point you seem to be making, that the reason why the manufacturer can't fit a double-insulated device with an earth connection is essentially a *legal* one, rather than a technical matter concerning safety or performance. But when it comes to the exact nature of the legal argument, I'm afraid you've left me more confused than ever, and I suspect I won't be alone.


THIS ISHU, JIM (BY DEFINITION) HAS HIS DOUBLE INSULATED, UNDECLARED ITEMS EARTHED ...& 'FLOATS' INDETERMINATELY ABOVE EARTH...
GOSH! OUR MUCH-VAUNTED 'GREATER SAFETY' HAS AMOUNTED TO NAUGHT!
FEDERAL SMOKE
ANOTHER ONE
SAA SAFETY AUTHORITY
SAA
AND YET.... PERFORMANCE DEFINITELY ISN'T DEGRADED!
©BEEJAY 88

For example, it sounds from one sentence in your letter that the prohibition against earthing a double-insulated appliance is to protect the *manufacturer* from possible legal action in the event of an accident. But in another part, it sounds as if the prohibition is to protect not the manufacturer, but the SAA – from any suggestion that its standard on double-insulation isn't adequate to ensure a safe device.

Frankly, the distinct impression I get from your letter is that about the only relevant person which the earthing prohibition *isn't* meant to protect is the poor old user – the very one who might get shocked or killed in the event of an accident!

What you seem to be saying is that if someone should get injured or killed when using a double-insulated appliance, both the manufacturer and the SAA must be absolved of any blame.

In the case of the manufacturer, this legal absolution somehow seems to hinge on the fact that if it does what the SAA says is safe and either doesn't suggest that an earth may be necessary, or (better still) makes no provision whatever for earthing, it can't possibly be to blame for any accidents.

Conversely the SAA's absolution seems to lie in the fact that since it has decreed that earthing of a double-insulated appliance isn't *necessary* for safety, it too can't possibly be to blame for any accidents providing (a) the manufacturer hasn't provided an earth, and (b) the manufacturer also doesn't do anything to suggest that an earth would in any way contribute to user safety.

I'm sorry, Jeff, but this seems like the kind of weird reasoning that only lawyers could accept as sensible. What you seem to be saying is that legally, a double-insulated device *must* be safe without an earth, because the manufacturer and the SAA both *say* it is safe without an earth. So that if someone gets injured or killed using it, neither the manufacturer nor the SAA can be to blame – because *by definition* the injury or death couldn't possibly be due to the lack of an earth!

Presumably the injury or death must be due to something else, also by definition, and therefore neither the manufacturer nor the SAA could be held responsible...

If this is indeed the situation, it seems to me an incredible example of legal buck-passing. And what makes it all the more amazing is that this legal morass surrounding the earthing taboo has developed despite the general agreement by most disinterested technical people that earthing can not only improve the performance of the device concerned, but quite possibly its safety as well. Indeed Jeff Richards himself concedes both these points, although he suggests that this is irrelevant.

So we have a situation where more and more audio and video gear is being sold in double-insulated form, and without either earthing or any provision to provide an earth for either improved performance or safety – *despite* the fact that most technical people are agreed that earthing can often be beneficial for both. And if I interpret Jeff Richards' letter correctly, he's saying that this is basically just to ensure that in the event of any accidents, neither the manufacturer nor the SAA can be held legally responsible.

Make sense out of that, folks, if you can. To me it sounds like something out of Lewis Carroll or Edward Lear. And legal jiggery-pokery aside, it still seems to leave us all in the position where in order to get the best performance out of our double-insulated equipment/systems, we may well need to perform surgery on it in order to provide the necessary earthing. But even where surgery isn't needed, simply providing it with an earth seems to be virtually ensuring that in the case of an accident, we will be held legally responsible.

There's no doubt about double insulation – it really solves a lot of problems, doesn't it? For the manufacturers, that is. As far as the consumer is concerned, it seems more like the proverbial bucket of worms. One could be excused, I think, for concluding that consumers' interests were not exactly paramount when the relevant standards and regulations were framed.

And so to the second letter on the subject, which concerns not so much the rationale behind the double-insulation safety standards, but the even more important matter of just how little these can actually be relied upon in practice, to protect the user from shocks.

The writer of this letter is Mr Simon Leadley, who is very experienced in audio and music engineering, a well-know technical author and a regular contributor to our sister publication *Sonics*. And his letter makes rather worrying reading:

I am writing to refer to you an incident that occurred in a piece of equipment that was termed Double Insulated, but was in reality Doubly Dangerous.

The equipment was from a well-known Japanese manufacturer of musical and hi-fi equipment that has in the past had a very good track record for reliability and safety. In this particular case, I received the equipment from the Australian suppliers for a review that would ultimately find its way into Sonics magazine.

In the usual excitement to see what this equipment sounded like, my colleagues and I unpacked the unit, placed it in a 19" rack (sorry it's not metric) and applied power. One of the other chaps reached over to turn up the volume and was flung across the room.

He complained that the unit was 'live'. We measured across from the chassis to ground, and sure enough there was 240 volts on the chassis. While we were measuring the voltage the chassis found earth and blew its internal fuse, scaring 10 years from my life in the process.

We took the unit to the workshop and took it apart to find the cause. The little symbol at the rear of the unit indicated that it was double insulated, so what had happened?

As soon as the top had been removed it was very clear what had happened. A wire that goes from the rear power plug to the power switch on the front had not been secured, and had been pinched between the lid and the outside chassis. The screw that secured the lid at this point had been screwed into the wire's insulation, and as the wire was unluckily the active, this made the chassis sit at 240 volts. The situation could have been just as serious if the neutral line had been the one pinched, because the unit could then have become an 'accident waiting to happen'.

Fortunately no one was really injured, but the point is that someone could easily have been killed. In America it was not an uncommon thing for musicians to be electrocuted by faulty equipment in the 1970's, because of the lack of an earth, while here in Australia the incidence of any serious danger has been very low – up until now!

The company that imported the unit immediately recalled all the other units, to check for a similar fault. I can't blame the manufacturer for poor safety standards, as they are apparently abiding by the rules. Although the factory check of the unit was not done, nor was the unit checked by the importers here in Australia. I know that some importers make sure that every unit is powered up before being sent to the retailers, a practice that I would like to see adopted by all importers.

In the audio field the problems of earth loops and hum have constantly plagued both home and live sound installations. I wish I had a dollar for every time I have hunted for the elusive loop. In fact most sound engineers have a de-earthed double adaptor, as part of their tools in trade for stubborn faults. This practice is pretty suspect and one that I don't embark upon unless I am really stuck. Although, in reality the problem of hum loops and earthing for safety reasons need not be something that is mutually exclusive.

Some of the more professional units that I have used make sure that the circuit board's earth and the chassis earth are completely separate, and then are joined with a low value resistor. This has the effect of swamping the induced hum currents caused by looped earth connections, but still allows the earth to provide a low impedance path to chassis in the event of a problem on the main circuit board. I have done modifications to some equipment that does just this; it works with no problems and I can sleep at night.

Another unit that I saw recently from another manufacturer and Australian distributor was not double insulated, but had capacitors that went from the active and neutral to ground for filtering purposes. But the chassis was not earthed, so consequently you got a 'tingle' every time you touched the unit. The microprocessor inside would also crash whenever you plugged an earthed lead into it. Again the importers apologised, and said that the unit shouldn't have found its way into the marketplace – but the fact remains that it did!

As I understand your Forum dissertations, the double insulated concept was originally designed to cope with power tools, and has only recently been gaining popularity for consumer electronics. It seems to me that there needs to be a complete rework of the standards as applied to the double insulation criterion, if these products are to be sold and operated safely.

To me, double insulated means just that – two layers of insulation between live power and the chassis. We can see that this isn't the case in the above mentioned examples. It is ironic that the double insulation concept has actually meant a lowering of safety standards!

I am also aware that the restrictions that apply to medical gear such as EEG units and other equipment that is connected directly to the human body are mindboggling. But take the case of an electric guitarist, who is essentially in the same boat. The guitar is connected directly to their body (the sweat of performance will make the contact exceptionally good) and the guitar is connected to various units that are connected to the mains. Consider what could happen if one of these units is the one I encountered, supposedly double insulated but in fact 'live'. Surely the same sort of standards that are applied to medical gear also need to be observed in this case.

Of course I am forgetting the most important consideration, cost! It would cost just too damn much to bring everything up to a standard such as that. It seems that the manufacturers, in order to make their units saleable to a number of international markets, do the least that they need to do in order to make the particular product 'legal'.

It seems to me that the various Government departments could spend their time better, by looking into potentially fatal problems as we are presented with here, rather than arguing with you over the use of stupid little box symbols on circuit diagrams. (Your symbols are far easier to read in my estimation, but I do think that in the age of fax machines 6k8 is a better solution to the problem of the missing decimal point. I get a lot of circuits via fax from the States, and it can be a problem – sorry, a quick digression!)

I do hope that this stirs up some reaction from your readers and the relevant

Government or statutory bodies.

I almost forgot – keep up the good work in a magazine that I have been enjoying for the last 16 or so years, ever since I discovered the magic of electronics when my father finally bought me that Philips 'Electronic Engineer Kit' for Christmas so many years ago. What was once a hobby is now a career, that is constantly changing and providing more challenges – and even lets me produce music.

Thanks very much for the letter, Simon, and for the kind words at the end. Your nasty experience with that piece of double-insulated gear with the live chassis is certainly pretty frightening, and does indeed suggest that not enough effort is being put into policing the safety standards in practice.

As you say, this slackness could easily have resulted in someone being killed. And I can't really see how the physical construction of the gear concerned could have passed the required safety regulations in the first place, if the internal mains wiring was not properly secured in a way which would make it *impossible* for a wire to be squashed between the lid and the chassis. My understanding is that this is an important requirement.

In short, if the prototype of the gear concerned had passed the basic safety requirements of the electricity authorities, it shouldn't have been possible for the wire concerned to have become squashed and make the chassis live – assembly error or not, and regardless of whether or not the importer had tested each production unit before despatch.

This sounds very much as if the gear concerned may never have been submitted for testing and approval. And perhaps this is still quite legal, as amplifiers and other audio equipment are probably not 'declared items' within the meaning of the regulations. In other words, currently there may well be no legal requirement for the manufacturer or importer to submit them for approval, before they are offered for sale.

My own view is that this is crazy. It's surely just as easy to be killed by a faulty amplifier or TV set as it is by a faulty electric blanket, hair dryer or battery charger, and the death in each case will be just as permanent. I find it very difficult to understand why one bunch of appliances is designated as 'declared' and the subject of rigorous testing and approval, while the other bunch is not so declared and can be made and sold without restriction (although still able to be legally withdrawn from sale if there is shown to be a safety hazard).

As Simon Leadley suggests, the growing trend towards so-called double-insulated appliances really seems to call for a major tightening up of safety requirements – for these appliances in particular. Since the safety of these appliances is made to rely so completely on the integrity and reliability of the internal insulation barrier or barriers, this suggests to me that all such appliances should really be declared items, and made to comply with the appropriate design rules.

Of course it would still be very desirable for all gear to be checked before sale, as Simon says. But it would be even more reassuring to know that the basic design has passed regulations which ensure that assembly errors can't produce a dangerous fault.

I guess I have to agree that it's a pity some of the bureaucrats don't spend a little more time and effort policing really serious matters like this, instead of giving me a hard time over the symbols we use in our circuits. But then, I'm probably a bit one-eyed about that, myself!

By the way, I'm still getting quite a few letters regarding the great circuit symbols debate. And I'd like to thank all those who have written in, mostly to offer their support. There's now no doubt in my mind that most readers want us to stick with our present symbols, and ignore the SAA/IEC symbols at least for the time being.

Here's one interesting little comment from Mr Garry Boyce, of Crafers in South Australia, who is I gather an engineering student:

Regarding the symbols controversy, I prefer the zig-zag resistor to the box – mainly because it is much easier to draw in a quick sketch. I have noticed that lecturers in electronics can draw a quick circuit diagram on a blackboard much more efficiently using the good old zig zag.

One of my lecturers has switched to the new little boxes. I find it takes him much longer to draw things on the board, and the difference between inductors, etc., is much less clear.

Thanks, Garry – an ironic observation indeed. The funny thing is that almost the only real advantage claimed for the IEC/SAA rectangular symbols as such, compared with the conventional zig-zag and 'curly' coil symbol, is that they are supposedly easier and quicker for humans to draw. If even *that* isn't true, then their protagonists really don't seem to have much of a leg remaining to stand on...

Another interesting letter came from Mr Graeme Harding, a consultant in acoustics, noise and vibration based in Surrey Hills, Victoria. Mr Harding sent copies of the circuit symbols used in yet another US publication, the journal *Contact* produced by University Sound, and promoted by the journal as a worthwhile standard.

As he points out, these symbols look almost identical to those used by *EA* and most other Australian magazines. Funny about that, isn't it?

Mr Harding also makes the very relevant comment that even if the SAA-/IEC symbols do supposedly save a small amount of drafting time, this time is saved for only one person – the one preparing the drawing. The 'older' symbols result in a time saving by all people who subsequently have to read the circuit and understand how it works. So overall, they're still likely to be considerably more efficient.

His final comments on this subject are again worth quoting:

I also serve on three SAA committees, and have been known to argue at length – and in vain – that aspects of a proposed standard do not reflect normal usage, and hence will be ignored. There are whole standards that are 'white elephants', in that they don't reflect common usage.

Of course it is right and proper that organisations such as SAA (and EA) should at times lead the rest of the community with regard to new ideas of all sorts, including standards. But of course you won't be leading if everybody is going in the opposite direction!

I couldn't have said it better myself, Graeme, and thanks for your support. I note that you also support our switch to 'mF' to represent millifarads, and would be willing to see us change over to the '1k5' system as well. Rest assured that your vote has been registered!

Now I must be honest here, and admit that there has been another letter which *didn't* support my stand. It wasn't actually sent to me, but to my boss – our publisher, Michael Hannan. So since it wasn't sent for possible publication, I can't actually publish the letter itself, or mention the correspondent's name, unless or until he gives permission.

But in fairness, I do believe I should give the basic thrust of his letter, because he did seem to be pretty upset. Essentially he seems to believe that my comments in Forum were over emotional, unprofessional and represented a deterioration in the quality of *EA*'s editorial standards.

Continued on page 144

Bundles of Books

New Releases . . .

GETTING THE MOST FROM YOUR MULTIMETER

R.A. Penfold **BP239**

This book is primarily aimed at beginners and those of limited experience of electronics. Chapter 1 covers the basics of analogue and digital multimeters — the merits and limitations of each. In Chapter 2 various methods of component checking such as transistors, thyristors and diodes are described. Circuit testing is covered in Chapter 3, with subjects such as voltage, current and continuity discussed.

102 pages **$11.00**

AN INTRODUCTION TO SATELLITE TELEVISION

F.A. Wilson **BP195**

A well written, comprehensive and easy to understand introduction to satellite TV, written for both enthusiast/technician and the interested lay person. Explains how satellite TV works, the equipment needed for reception, how to work out antenna orientation for your location, correct installation and so on. Lots of reference tables, formulas for calculations and a glossary of satellite TV jargon.

104 pages **$12.95**

MORE ADVANCED ELECTRONIC MUSIC PROJECTS

R.A. Penfold **BP0174**

Intended to complement the first book (BP74) by carrying on where it left off and providing a range of slightly more advanced and complex projects. Included are popular effects units such as flanger, phaser, mini-chorus and ring-modulator units. Some useful percussion synthesisers are also described and together these provide a comprehensive range of effects including drum, cymbal and gong-type sounds.

96 pages **$8.50**

MIDI PROJECTS

R.A. Penfold **BP0182**

Provides practical details of how to interface many popular home computers with MIDI systems. Also covers interfacing MIDI equipment to analogue and percussion synthesisers.

112 pages **$11.00**

BUILD YOUR OWN SOLID STATE HI-FI AND AUDIO ACCESSORIES

M. H. Babani **BPO220**

An essetial addition to the library of any keen hi-fi and audio enthusiast. The design and construction of many useful projects are covered including: stereo decoder, three-channel stereo mixer, FET pre-amplifier for ceramic PUs, microphone pre-amp with adjustable bass response, stereo dynamic noise filter, loud-speaker protector, voice-operated relay, etc.

96 pages **$6.00**

POWER SUPPLY PROJECTS

R.A. Penfold **BP0076**

The purpose of this book is to give a number of power supply designs, including simple unstabilised types, fixed-voltage types, and variable-voltage stabilised designs, the latter being primarily intended for use as bench supplies for the electronics workshop. The designs provided are all low-voltage types for semiconductor circuits. This book should also help the reader to design his own power supplies.

96 pages **$7.50**

ELECTRONIC HOBBYISTS HANDBOOK

R.A. Penfold **BP233**

A handy data reference book, written especially for the newcomer to electronics. Provides data on component colour codes, IC families, basic power supply circuits, circuit symbols, op-amp connections, testing transistors and SCRs, basic computer interfaces, morse code and lots more.

$16.00

COIL DESIGN AND CONSTRUCTION MANUAL

B.B. Babani **BP0160**

A complete book for the home constructor on "how to make" RF, IF, audio and power coils, chokes and transformers. Practically every possible type is discussed and calculations necessary are given and explained in detail. All mathematical data is simplified for use by everyone.

96 pages **$9.50**

CHART OF RADIO, ELECTRONIC, SEMICONDUCTOR AND LOGIC SYMBOLS

M.H. Babani B.Sc (Eng) **BP0027**

Illustrates the common, and many of the non-so-common, radio, electronic, semiconductor and logic symbols that are used in books, magazines and instruction manuals, etc. in most countries throughout the world.

Chart **$4.00**

HOW TO DESIGN ELECTRONIC PROJECTS

R.A. Penfold **BP0127**

The aim of this book is to help the reader to put together projects from standard circuit books with a minimum of trial and error, but without resorting to any advanced mathematics. Hints on designing circuit blocks to meet your special requirements where no "stock" design is available are also provided.

128 pages **$9.00**

HOW TO GET YOUR ELECTRONIC PROJECTS WORKING

R. A. Penfold **BP0110**

The aim of this book is to help the reader overcome problems by indicating how and where to start looking for many of the common faults that can occur when building up projects.

96 pages **$8.50**

AUDIO AMPLIFIER FAULT-FINDING CHART

C.A. Miller **BP120**

A very useful fold-out chart which will guide almost anyone in tracking down faults in audio amplifiers, systematically and quickly. Includes detailed notes.

$4.00

IC 555 PROJECTS

E.A. Parr **BP0044**

Every so often a device appears that is so useful that one wonders how life went on before without it. The 555 timer is such a device. Included in this book are basic and general circuits, motorcar and model railway circuits, alarms and noise-makers as well as a section on 566, 568 and 569 timers.

$9.50

RADIO AND ELECTRONIC COLOUR CODES AND DATA CHART

B.B. Babani **BP0007**

Covers many colour codes in use throughout the world, for most radio and electronic components. Includes resistors, capacitors, transformers, field costs, fuses, battery leads, speakers, etc.

Chart **$4.00**

INTERNATIONAL RADIO STATIONS GUIDE

P. Shore **BP255**

A new and completely rewritten edition of this very handy reference manual for both amateur and professional broadcasting listeners. It provides comprehensive listings of broadcasters on all major international bands — short wave, long wave and medium wave. The listings are according to frequency, and give country, location, power and station ID. Also given are ITU country codes and time differences from GMT.

312 pages **$16.00**

ELECTRONIC CIRCUITS FOR THE COMPUTER CONTROL OF ROBOTS

R.A. Penfold **PB0179**

Provides information and circuits on computer control of electric motors (including stepper types), plus a range of useful sensors including visible light, infra-red, and ultrasonic types.

96 pages **$11.00**

TO ORDER THESE BOOKS:

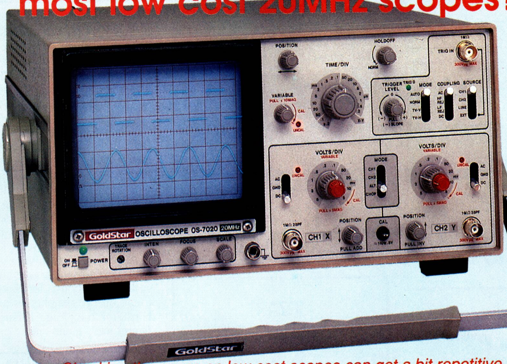
Simply fill out the coupon attached and put it in the reply paid envelope supplied. If the coupon and envelope are missing, send your name address, phone number, and a list of book(s) you want, complete with cheque, money order or credit card details (card type, card number, expiry date and signature) to:

Freepost No.4,
Electronics Australia Books Offer,
Federal Publishing Company
PO Box 227, Waterloo NSW 2017.

Note: In calculating your remittance, add $1.50 per book to the total cost of the books you are ordering to cover package and postage. All orders must be accompanied by a signature — unsigned orders cannot be accepted. As these books are imported, unavoidable delays may occur. Please allow 4 weeks for delivery. If you have any enquiries regarding mail orders, phone (02) 693 9925.

EA FEB '89

Can you spot the eight features on this scope that you won't find on most low cost 20MHz scopes?



Checking the specs on low cost scopes can get a bit repetitive - Yes, they all have 20MHz bandwidth and Yes, they've all got 6" rectangular screens. Some have1mV max sensitivity. So what's different about the New Goldstar OS7020?

1. Variable Sweep Control incorporating x10 Magnifier

Simply adjust the sweep to give a suitable trace then pull control for a x10 magnified image.

2.Uncal Warning Lights

When the timebase or input controls are not in their calibrated positions you'll see a warning light - handy if you're taking measurements.

3.Triggered LED

If the input level is sufficient to trigger the OS7020, then this LED is illuminated. Saves a lot of time fiddling when you're not certain that you've got proper triggering.

4. TV-V & TV-H Triggering

These switches are a further aid to triggering and are particulrly useful for the TV service technician.

Also enquire about the OS7040 scope. 40MHz/1mV with delayed sweep.

$1380 inc tax with 2 probes.
$1150 ex tax with 2 probes

5. Trigger Hold-Off

Another aid to triggering - use this control to delay the sweep on complex waveforms

6. Professional Tilt Handle.

Many manufacturers take a short cut and give you a cheap carry strap. Not so on the Goldstar OS7020; you get a professional multi-position tilt handle.

7. 1mV maximum Sensitivity

Use the built-in x5 magnifier to get 1mV/div maximum sensitivity.

8. Made by GoldStar

Your guarantee of quality. The OS7020 is designed and built in Goldstar's own factory. Many of the parts are specially made by GoldStar. That's why we can offer a *one year warranty* and extra features at no extra cost!

Check these prices !

$888 ***inc tax complete with two high quality switchable probe kits***

$740 ex tax with probes

You've Gotta Getta Goldstar Scope from :

A.C.T. John Pope Electrical 80 6576 ● J Blackwood & Sons 80 5235 ● George Brown 80 4355
N.S.W. George Brown 519 5855 Newcastle 69 6399 ● Ames Agency 699 4524 ● J Blackwood & Sons ● Auto-Catt Industries 545 1322 ● D.G.E. Systems (049) 69 1625 ● W.F.Dixon (049) 69 5177 ● Macelec (042) 29 1455 ● Newtek (042) 27 1620 ● Novacastrian Electronic Supply (049) 62 1358 ● Obiat Pty Ltd 698 4776 ● David Reid 267 1385 ● Digitel 709 6511 ● Geoff Wood 427 1676
N.TERRITORY J Blackwood & Son (089) 84 4255, 52 1788 ● Thew & McCann (089) 84 4999
QUEENSLAND Auslec 854 1661 ● George Brown 252 3876 ● St Lucia Electronics 52 7466 ● L.E.Boughen 369 1277 ● B.A.S. Audiotronics 844 7566 ● Colourview Wholesale 275 3188 ● E.C.Q. Electronics 376 5677 ● The Electronics Shop (075) 32 3632 ● Thompson Instruments (Cairns) (070)51 2404 ● Solex (Townsville)(077) 72 4466 ● Xanthos Electrical (079) 27 8952
S.AUSTRALIA George Brown 212 3111 ● J Blackwood & Sons 46 0391
TASMANIA George Harvey (003) 31 6533 (002) 34 2233
VICTORIA Radio Parts 329 7888 ● George Brown Electronics Group 878 8111 ● G.B. Telespares 328 4301 ● J Blackwood & Sons 542 4321 ● The Electronic Components Shop 670 6474 ● Factory Controls (052) 78 8222 ● Mektronics Co 690 4593 ● Truscott Electronics 723 3094 ● A.W.M. Electrical Wholesalers
W AUSTRALIA Atkins Carlyle 481 1233 ● Dobbie Instruments 478 1366 ● George Brown 362 1044
PAPUA NEW GUINEA T E (P.N.G.) Pt Moresby 25 6322 Lae 42 6246

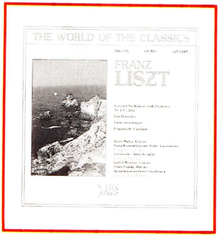
**Gotta
Getta
GoldStar**

Dealer enquiries welcome. Call (02)736 2243
Recommended prices only

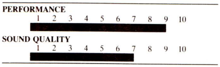
Compact Disc Reviews

by RON COOPER

LISZT



Franz Liszt
Symphonieorchester Radio Luxemburg
Nurnberger Symphoniker
Symphonieorchester Innsbruck
VMK Globe 100.41805 DDD/ADD
Playing time: 60 min



Here is another new budget label at $9.90, from the same importers which have the ZYX label (see last month's review for address). This disc features popular works of Franz Liszt as follows: Konzert fur Klavier und Orchester Nr. 1 Es-Dur (DDD); Les Preludes, Symphonische Dichtung Nr.3 nach Lamartine (ADD); Valse impromptu (DDD); Valse Nr. 4 aus Valses oubliees (DDD); Ungarische Fantasie (ADD).

The Piano Concerto No.1 was first performed, with the composer as soloist and Hector Berlioz conducting, at Weimar in 1851. It is a magnificent piece, obviously written for the composer's talent as a virtuoso pianist. It is expertly performed here by Joseph Bulva, though the recording places the piano well back in the orchestra with the brass section predominating.

The symphonic poem 'Les Preludes' was composed in 1854 and is an impressive, colourful work. This performance is very well played with good tempos and fine overall balance. Though this track is an analog one, there is virtually no background noise.

The piano pieces are likewise well played, but recorded digitally with no background noise.

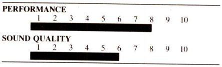
Probably the best recording on this disc is the Hungarian Fantasy which is a brilliant work, exploiting Hungarian folk tunes from near his birthplace. This track is analog and does have light noise intrusion in the quiet passages.

A good overall recording and well worth the price.

MOZART

MOZART
CLS 4004
DIGITAL
61 MIN
Salzburger Sinfonien · Salzburg Symphonies
No. 1–3 KV 136–138 – Eine kleine Nachtmusik KV 525
Camerata Academica Salzburg
Dir./Cond.: Hermann Abel, Alexander von Pitamic

Salzburg Symphonies 1-3
Eine kleine Nachtmusik
Dir./Cond.: Hermann Abel, Alexander von Pitamic
CLS 4004 DDD
Playing time: 61 min



Here is an interesting low priced disc from ZYX classics of early Mozart, containing 3 symphonies and Eine kleine. The full content is "Salzburg Symphony" No.1; "Salzburg Symphony" No.2; "Salzburg Symphony" No.3; and "Eine kleine Nachtmusik".

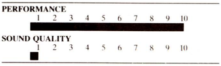
These early symphonic works of Mozart show a strong influence by J.C. Bach and are based on the Italian sinfonia. Although they are called symphonies, they are much simpler in style or content than the later popular symphonies. In fact on this disc, the most symphonic work is probably the "Eine kleine" which of course is not a symphony but a serenade. It does have four movements though, whereas the early symphonies have three short movements with the main emphasis on the first one.

The playing on this very low cost ($9.90) disc is first class, as you would expect from an ensemble from Mozart's home town. It represents good monetary value, although the all-digital recording is not quite up to standard. It has an over bright presence, which creates a certain hardness to the sound and leads to bass or treble diminution.

As the surface is very quiet it does lend itself to tone correction and I suggest 6-8dB boost for both bass and treble on the symphonies and 6dB bass boost for the "Eine Kleine" but these figures are a guide only.

CARUSO

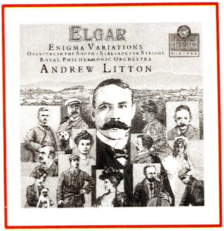
Enrico Caruso
Romanze da Opere
Canzoni Napoletane
Melodie e canzoni
BM-CD 8001 AAD
Playing time: 54 min 58 sec



Another new label here, also from the importers of ZYX, of reprocessed recordings from the past. In this case the recordings are by Caruso, possibly the greatest singer of all time. The pieces are: RIGOLETTO: 'La donna e mobile' (1908 – Verdi); LA BOHEME: 'Che gelida manina' (1906 – Puccini); LA GIOCONDA: 'Cielo e mar' (1910 – Ponchielli); LA TRAVIATA: 'Libiamo, libiamo' (1914 – Verdi); TOSCA: 'Recondita armonia' and 'Eluceal le stelle' (1909 – Puccini); I PAGLIACCI:'recitar-Vesti la giubba' (1907 – Leoncaballo); IL TROVATORE: 'Di quella pira' (1906 – Verdi); ANDREA CHENIER: 'un di dall'azzurro spazio' (1907 – Giordano); CABALLERIA RUSTICANA: 'Siciliana' (1910 – Mascagni); 'O Sole Mio' (1916); 'Santa Lucia' (1916); 'Addio A. Napoli' (1919); 'Fenesta Ca Lucive' (1913); 'Core 'Ngrato' (1911); 'Musica Proibita' (1917); 'Vieni Sul Mar' (1919; and 'Baghissima Sembianza' (1920).

There is a fair amount of noise, which is to be expected from these historical recordings. But there is very little high note distortion, often heard from such recordings. The technicians have done an excellent job from these ancients, and it certainly allows you to hear Caruso better than you would have done before. Obviously though the sound quality must rate low – but nonetheless an excellent disc for Caruso fans.

ELGAR


ELGAR
ENIGMA VARIATIONS
OVERTURE IN THE SOUTH · SERENADE FOR STRINGS
ROYAL PHILHARMONIC ORCHESTRA
ANDREW LITTON
virgin classics
DIGITAL

Enigma variations
Overture in the South
Serenade for Strings
Royal Philharmonic Orchestra
Virgin Classics VC 7 90727-2 DDD
Playing time: 65 min

PERFORMANCE
1 2 3 4 5 6 7 8 9 10
▬▬▬▬▬▬▬▬▬

SOUND QUALITY
1 2 3 4 5 6 7 8 9 10
▬▬▬▬▬▬▬▬▬

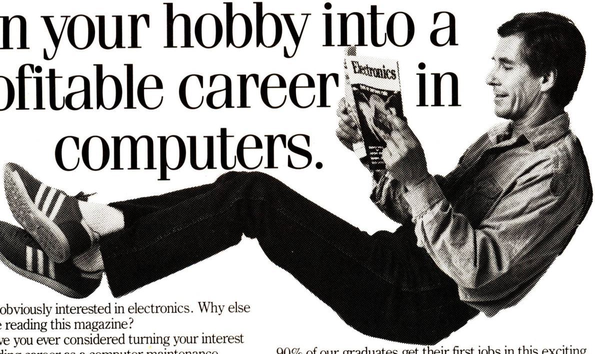
This is an excellent disc of these compositions of Sir Edward Elgar. If you are unfamiliar with Elgar, you will not be though, with 'Land of Hope and Glory' – although that is part of his pomp and circumstance marches, not on this disc.

The overture 'In the South' is a colourful tone poem, similar to some of those of Richard Strauss and was inspired by Elgar's visit to Italy in 1903. It features brilliant passages of strings and brass with quiet reflecting interludes. The serenade for strings is a familiar work which was one of Elgar's favourites and the last work recorded by him.

The main title of this disc is the "Enigma Variations" and rightly so, a most profound work, not unlike Brahms and one which can bring a lot of deep musical pleasure. It depicts musical character portraits of Elgar's friends – some of them eccentric and is a very dynamic work with many contrasting and toneful passages.

The playing under this unfamiliar conductor is very good, with excellent tempo. The recording is full and well balanced, with excellent acoustics (try track 16 and the finale), and is the best version I have heard to date – well worth the full price. EA

Turn your hobby into a profitable career in computers.



You're obviously interested in electronics. Why else would you be reading this magazine?

But have you ever considered turning your interest into a rewarding career as a computer maintenance engineer?

The Control Data Institute can help you fulfil your goal in the shortest possible time by teaching you such subjects as basic electronics, microprocessors, data communication, disk drives and machine language programming.

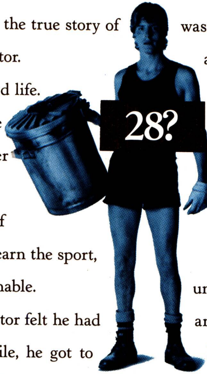
We then help you further by helping more than 90% of our graduates get their first jobs in this exciting, expanding industry.

Don't delay, contact Control Data now.
Sydney 4381300, Melbourne 2689666.

CD CONTROL DATA INSTITUTE
A computer career starts here.

Sanford Vick 2003.

At what age are you c



Allow us to tell you the true story of a SCUBA-diving instructor.

He had a pretty good life.

The small school he operated on the Barrier Reef was doing alright.

There were plenty of tourists who wanted to learn the sport, so the income was reasonable.

All in all the instructor felt he had it made. But after a while, he got to thinking, "What am I going to do when I get older? I can't spend the rest of my life diving."

Too old for new tricks?

His friends thought he was worried about nothing. "Just about anyone would give their right arm to do what you do," they said. "And besides, you're only 22." Still, the instructor's concern continued, so he looked at a paper to see what was going, and made a few calls.

The enquiries led him to the conclusion he'd suspected; that he was too old for any worthwhile training or apprenticeship schemes.

Even if he'd been 18, he was told, he'd have been considered a dog too old for new tricks. This story does have a happy ending, however.

Can you do something about it?

The instructor sent off a coupon not unlike the one you see in the bottom corner, and subsequently found out about the RAAF's Adult Technical Training.

The instructor's plight, in fact, was not unusual. There'd be thousands of men and women who discover some time in their lives that they are dissatisfied with their jobs, and want to start afresh. This is where the RAAF can help.

We can retrain you as an aircraft technician if you're between 17 and 34.

Working with jet engines, navigation systems, armaments and the like, may be something you've never considered.

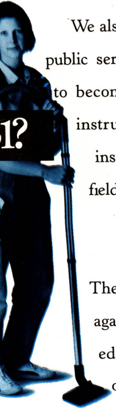
Out of your depth?

Indeed, you may feel you'd be completely out of your depth in such a highly technical

nsidered over the hill?

environment. But there's a good chance that this may not be the case.

We could tell you, for instance, the story of the 30-year-old railway ticket collector who can now put a Hercules engine together in his sleep. Or there's the 28-year-old former bricklayer who's now an expert on F/A 18 airframes.



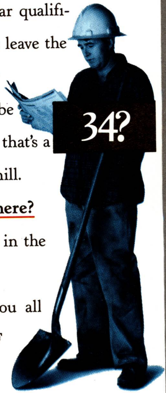
We also have a female clerk from the public service, who at age 22, decided to become an expert on aeronautical instruments. Our SCUBA-diving instructor made ground radars his field of expertise.

The School of Life?

The point being made is this: The RAAF won't discriminate against you because your further education has been in the School of Life.

In fact, if anything, we feel that your age and experience would make you a more desirable employee for these reasons.

Reflecting this, the Adult Technical Training we'd put you through lasts around 12 months. Apprentices, on the other hand, take four years to gain similar qualifications. When you decide to leave the RAAF, you'll soon discover that, with your skills, you'll be at the top of your field. And that's a far cry from being over the hill.



Where do you go from here?

Your next step is to fill in the coupon and send it off.

In return, we'll post you all the information on RAAF Adult Technical Training.

You must hold Australian citizenship, and have completed (or be completing) your schooling to year 10 with passes in English, Maths and Science (with a Physics content).

To: RAAF Careers, Freepost 2600AF,
GPO Box XYZ (in the Capital City nearest you.)
Name ______________________________
Address ______________________________
______________________ Postcode __________
Telephone ______________ Date of Birth ______________
Highest Educ. level attained or being studied ______________

Or phone an RAAF Careers Adviser on Adelaide 237 6222. Albury 218277. Bendigo 412500. Brisbane 226 2626. Canberra 57 2311. Geelong 211588. Hobart 34 7077. Launceston 311005. Melbourne 696 2905. Newcastle 26 3011. Parramatta 635 1511. Perth 325 6222. Sydney 219 5555. Townsville 72 4566. Wollongong 28 1855.

ADULT TECHNICAL TRAINEES RAAF

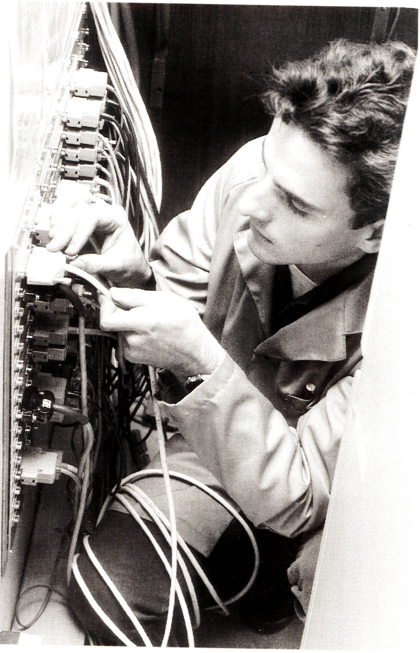
RTT 227.DPS.78 Authorised by the Dept. of Defence.

A guided tour of

Cabling & connectors

Plugs, sockets and wires all form a major part of electronics. Because the range has become so extensive, we thought it timely to look at connectors and cabling in general.

by PETER PHILLIPS



Humble plugs and sockets are taken for granted in many instances, as they serve such a basic function. The bit of copper in between is hardly a topic for stimulating dinner conversation, either. But without the connectors and the wires, we would either need energy transmission by wireless or go back to the steam age.

Because of the many applications of electronics, and the range of environments that electronics gear must operate in, a lot of different types of plugs and sockets (connectors) have been developed over the years. Likewise, different applications use various types of electrical cables, and this range is ever expanding as well.

In this article we offer a guided tour of some of the more commonly used connectors and types of cabling. It's a big field, perhaps more complex than you might first think, and we cannot hope to cover the lot.

We start with cabling, then examine the types of connectors commonly used, along with typical applications.

Wiring

Although a printed circuit board effectively 'wires' all the onboard components together, additional wiring is usually required to interconnect the PCB to other devices. Often there are peripheral devices such as switches, other PCBs, indicator lights, the power supply and other devices being controlled by the PCB, which for ease of servicing are connected by plugs and sockets.

Usually, wiring within an electronic circuit can be classified as either power or signal wiring. Power supply wiring generally means using a relatively heavy gauge of wire compared to signal wire. Power wiring requirements are determined by the values of voltage and cur-

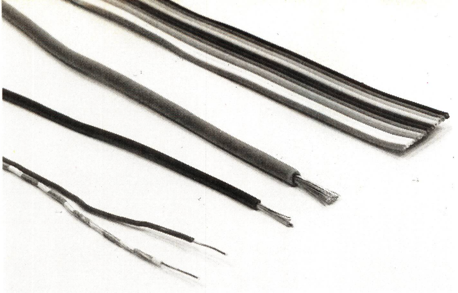


Fig.1: The most commonly used wires in electronics. From the top, picture shows 12 way colour coded ribbon cable, 7.5 amp hook-up wire, 2 amp hook-up wire and 0.6mm (dia) telephone wire.

rent being distributed, where the voltage determines the insulation requirements of the wire, and the current the size of the wire itself.

As well, different types of signals need to use cabling designed for the purpose. A special type of signal wire, usually referred to as 'co-ax', is commonly used for signal distribution, and we will examine this type of cabling later. Fig.1 shows some of the varieties of cables used in electronics.

Single strand wire.

Single strand wire can be either enamel-insulated winding wire, electrical power wire, or signal wire such as that used by Telecom.

Winding wire is usually sized by either the B&S standard (Brown & Sharpe, also referred to as the American Wire Gauge AWG); the Standard Wire Gauge (SWG); or the metric gauge. In general, the larger the SWG or B&S number, the smaller the diameter of the wire. The metric gauge is now the standard, and simply specifies the diameter of the wire in millimetres.

One point of confusion is the use of the word 'mil'. This is an imperial unit, and equals one thousandth of an inch. A millimetre is usually written in shorthand as mm, although verbal reference to the millimetre as a 'mil' is common. Confusing stuff!

Tables relating the various winding wire sizes, along with resistance per unit length are useful, and a wall chart detailing this information is essential if you are into coil winding.

Electrical power wire is not generally used in electronics, except in applications involving electrical power control. In this case the power wiring from the main switch board to the electronic controller would be the responsibility of a licensed electrician, while the electronics itself becomes the province of the technician. It is not uncommon for the electrician to have the necessary technical skills to handle both aspects, and a short look at electrical wire is not totally out of place.

Electrical power wire size is generally plastic insulated and identified in *square millimetres*, and can be single or multistrand. For example, a typical lighting circuit uses electrical wire of 1 square millimetre (1mm^2), which has a current rating (open air) of 16 amps. Power point wiring is usually run with 2.5mm^2 wire, giving a current handling capability of 28 amps.

Because heavy gauge single strand wire can be difficult to handle, multistrand wire is also used. The size of the wire is often given in two ways, either as an equivalent in square millimetres or as the number of strands/diameter. The multi-strand version of power point wiring (2.5mm^2) is 7/0.67, which means there are seven strands of wire, each of 0.67mm diameter.

It is also common for wire manufacturers to give the diameter of single strand wire as well, so 2.5mm^2 wire might also be marked as 1/1.76 – or one strand of wire with a diameter of 1.76 millimetres.

If you are not properly trained in the electrical wiring field, it is best not to undertake this type of wiring. There are many rules (Standards Association of Australia – SAA wiring rules) that must be obeyed, and an electrician will have studied these and passed an exam before being given a licence to perform wiring tasks. Telephone wire and bell wire are other types of single strand wire, and like power wire both types have plastic insulation rather than the enamel type insulation as used in winding wire. Telephone wire is useful for breadboarding, (or even for telephone connections!), but should not be used where flexing of the wire is likely. It is very useful for insulated wire links on a PCB, or wherever permanent undisturbed wiring is required.

Another type of single strand wire is tinned copper wire. This type of wire is available in the same sizes as winding wire, and a roll of either 22 or 24 SWG tinned copper wire is useful to have on hand for making uninsulated PCB links.

Multi-strand wire

Multi-strand wire is available in various sizes, and is usually measured by number of strands x diameter of each strand. Sometimes, only the current rating for the cable is given and you are left guessing as to the actual size of the wire.

A typical low current, (around 1-2 amps), general usage wire size is the 10 x .025mm size (or 10/10 as it was called in pre-metric days). For heavier currents, (7.5 amps), the 24 x 0.2mm (23/.0076) size is used. These types of wires are often referred to as 'hook-up' wire.

The grading of the insulation is important, particularly where mains voltages are involved. Usually insulation rated to withstand 250V AC is either stamped on the insulation itself, or the wire reel. If it is not, then play safe and don't assume it can be used for mains wiring.

Where the voltage exceeds 1kV, the use of specially insulated wire is necessary. Known as EHT cable, this wire is commonly used in TV sets to supply the EHT to the picture tube. Also, spark plug wiring in motor cars uses a very thick insulation, and may even have a carbon track for the conducting medium, rather than copper.

Normally, high voltage wire will only be required to pass low currents, and the actual conductor can have a high resistance without causing any problems. For example, a TV picture tube current is usually less than a milliamp, so a resistance of 1M ohm within the EHT wiring to the tube will cause a voltage drop of 1000V. However, what's a drop of 1000V when you have 25kV to start with? In fact, in the interests of preserving life and limb, it is common for EHT wiring to have a high resistance.

In the interests of both safety and correct circuit performance, it is essential to use the right size wire for power wir-

Utilux Is Making The Connection Between . . .

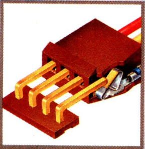
FLEXIBILITY & RELIABILITY

Intensive QC programmes provide reliable connectors that stand up to tough environmental conditions in a wide range of electronic applications.

Eleven different components are your building blocks for thousands of interconnection solutions.

Utilux/Molex's unique family of KK® connectors provide the flexibility you need to build interconnections precisely suited to your applications.

Choose either tin or cost-effective selective gold plating, 2.54mm or 3.96mm centre spacing. Crimp, solder, or insulation displacement termination . . . top, side, or bottom pin entry . . . break-to-size pin headers . . . they're all standard in thousands of demanding applications.



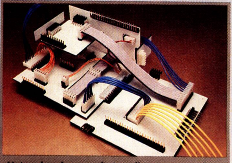
Gold plating placed selectively on terminal contact points means added economy.

The KK® connector is just one example of how we take a total systems approach.

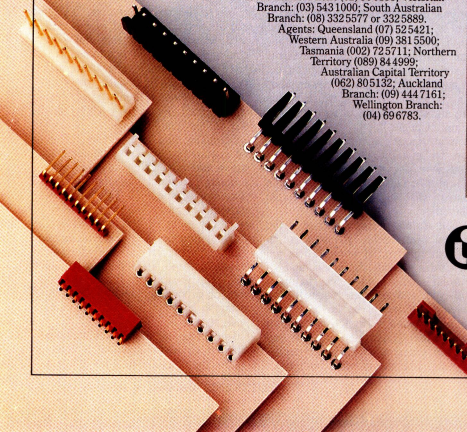
The KK® System includes a complete line of wire termination tooling from simple hand crimp tools to the latest automated insulation displacement technology. The System also features sophisticated pinsetting equipment. Utilux goes beyond merely supplying connectors to help today's manufacturers achieve lower installed costs.

For more information contact your local Utilux office.

Head Office: Phone (02) 50 0155; Victorian Branch: (03) 543 1000; South Australian Branch: (08) 332 5577 or 332 5889. Agents: Queensland (07) 52 5421; Western Australia (09) 381 5500; Tasmania (002) 72 5711; Northern Territory (089) 84 4999; Australian Capital Territory (062) 80 5132; Auckland Branch: (09) 444 7161; Wellington Branch: (04) 69 6783.



Unique break-away design allows you to order pin headers in bulk and break off the exact lengths you need to save on inventory and waste.



UTILUX
people with imagination

Advertising Planners 317B

ing. Many unpredictable faults can be introduced into a circuit by using power wiring of too light a gauge. If the circuit consumes two amps, use a wire size that has at least a five amp rating. Also, power wiring should be as short as possible, and correctly clamped at either end to ensure optimum safety.

Other multi-strand wire includes speaker wire, mains rated power cable (including so called figure-8), and various cable formats containing a number of individually insulated cables.

One rather interesting cable type is the highly flexible cable as used in meter test leads. This type of wire may have over 500 strands of very fine wire, and will have a low resistance per unit length – as well a relatively high price per unit length!

The main considerations with all these types of wire are: use the most appropriate size wire for the task, use colour coding were possible, (e.g., red for positive, black for negative, blue for signal, etc.), and ensure that the insulation and current-carrying capacity are adequate for the voltages being used.

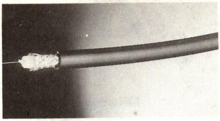
Signal wiring

Signal wiring generally only requires a light gauge. Where a number of signal wires need to be taken from one area to another, the use of multi-coloured ribbon or 'rainbow' cable provides a neat and more easily traced job. Rainbow cable comes in various sizes, and 12 or 16 colour coded multi-strand wires moulded into a flat strip are typical formats.

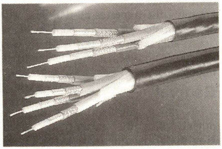
So-called computer cable is similar to rainbow cable in format, but is generally designed to be used with quick-connect connectors, (IDCs, or insulation displacement connectors), and has only very limited colour coding.

The use of 'hookup' wire is also common for signal transfer applications, and using different colours provides easy tracing of the wiring. It also good practice to run this sort of wiring in a 'loom'.

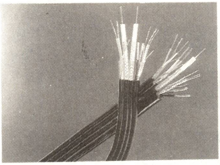
A loom is an arrangement to keep all the wiring together, and may be made by feeding the wires through plastic sleeving, or binding with nylon ties, tape or even string to form a single tidy bundle or 'trunking'. Signal wiring should be as short as possible, and located away from heat sources, power transformers and any high energy areas of the circuit.



Co-axial cable. This example has low capacitance per metre (35pF/m) because of the single inner conductor and the thick polyethylene insulation around it. It is suitable for RF applications and has a characteristic impedance of 125 ohms. Photo courtesy of Belden Electronics.



Multi-core co-axial cable. Each cable has double shielding giving low cross-talk between cables. The shielding of each cable is also insulated from the others. Photo courtesy of Belden Electronics.



Multifunction cabling. Here co-axial cables are mixed with shielded cables and non-shielded cables in one ribbon moulding. Photo courtesy of Belden Electronics.

A particularly specialised type of multi-strand wire is *Litz* wire. This type of wire comprises a number of separate insulated strands of copper wire, joined at both ends of the length being used. Litz wire is used to overcome the so-called 'skin-effect', which is the tendency for high frequency current to flow on the outside of the wire, due to the repelling action between the electrons.

By using a number of parallel insulated conductors, the skin effect is spread over each conductor, giving a collective effect that is much less than that for an equivalent size single conductor. Skin effect becomes significant at high frequencies, and many high frequency inductors are wound with Litz wire.

Many computer power supplies use switch-mode operation, and the main transformer will often be wound with a heavy gauge Litz wire. Note that each strand is insulated, otherwise the skin effect is not isolated to each individual strand.

Co-axial cable

Co-axial cable is another type of wire commonly used for electronic signal distribution and, predictably, comes in many varieties. There is a distinction between *co-axial* and *shielded* cable which is worth describing.

Shielded cable refers to co-axial style construction, where a central wire (or wires) are insulated and then shielded by a surrounding metal braid or foil of some sort. Shielded cable is designed for audio or video frequencies, and will have a capacitance per unit length specification. The outer braid is normally connected to the common line of the circuit (earth) which allows it to provide an electrical shield for the central wire.

Co-axial cable has a similar type of construction, but is designed and manufactured to tighter specifications, making it suitable for use at high frequencies (RF – radio frequencies). Employing special types of insulating materials, co-axial cable is specified by its *characteristic impedance* value.

It is possible to use co-axial cable in place of shielded cable, although it's more expensive – but never try to use low cost shielded in place of co-axial. Common parlance generally refers to all shielded cable as 'co-ax.', but the distinction is important as we will show.

Shielded cable

Shielded cable is available in various styles, including groupings of individual cables either surrounded by a common shield or individually shielded. The shield is normally connected to the common, or earth point of the circuit.

Shielded cable is usually rated by its capacitance per metre. A value of 100pF/m is considered fairly low, while 200pF/m is typical. The capacitance rating becomes important if the wire length is substantial, or if the signal frequencies involved exceed 1MHz. If the impedance of the circuit is low, (around 100 ohms or less), the capacitance of the cable is not as critical, particularly for audio uses. For video frequency applications, a low capacitance cable should be used.

Cabling

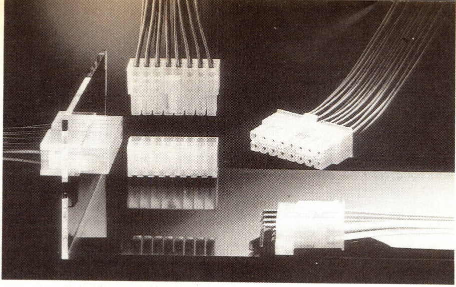
Another concern involves the amount of signal isolation provided between adjacent shielded conductors within the cable. Different construction techniques provide various degrees of isolation; again important when cable lengths exceed more than a few metres.

RF co-axial cable

Co-axial cable is required in applications involving the transfer of signals with a frequency greater than 3 or 4MHz (radio frequencies).

A common example is the distribution of the signal from a TV antenna, where frequencies of 100 to 220MHz are usual. The impedance rating of the cable in this case should be 75 ohm, to match the impedance of both the signal source (antenna) and the load (TV set). This *impedance matching* is essential for optimum transfer of the signal. Usually the impedance of the devices being connected determines the required impedance specification of the cable.

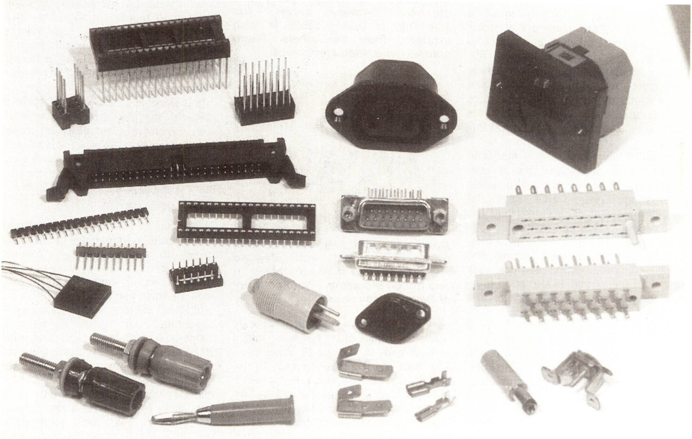
Other characteristics of co-axial cable include its capacitance per metre, and its transmission loss at a specified frequency (in dB/10 metre). A low loss 75 ohm co-axial cable would have a loss of around 1dB/10 metres at 100MHz, with a capacitance of about 60pF/m. How 'lossy' the cable is depends on its construction, and bears no relation to its impedance.


Some of the Molex range of miniature high current connectors. Photo courtesy of Utilux.

General

No doubt you can think of many other cables we haven't mentioned. How about flat ribbon cable for TV signals perhaps? To answer that one we would need to examine the whole field of transmission lines. Because we are generalising, we will steer away from this area, as its complexity deserves an article on its own.

And there is also the topic of cable insulation materials. Most commonly available cables are covered with a form of PVC plastic, which is flexible and long lasting. However it is not suitable for high temperature applications, and is easily cut by a sharp edge.


Miscellaneous connectors. Most of these are suitable for coupling power, excepting the group in the top left, which are either IC sockets or multiway connectors for digital data. Note the two fuses in the IEC 240V plug receptacle.

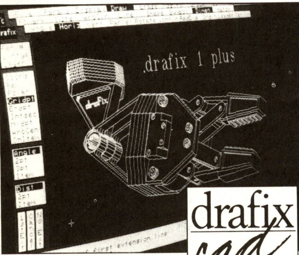
JOHN BARRY GROUP *are your exclusive distributors for:*

LEMO SWISS MADE CONNECTORS

42 years ago **LEMO** pioneered the simple self-latching style connector.
They now have connectors co-axial; high voltage; combination; audio; video; and environmentally sealed versions.

DISTRIBUTED BY: JOHN BARRY GROUP • AUSTRALIA

Sydney (02) 439 6955 Melbourne (03) 646 4088 Perth (09) 242 2944



drafix cad

High Performance CAD Package

NOW
$395
EXCLUDING TAX
POST FREE IN AUSTRALIA

Drafix is a menu driven design package providing unlimited zoom and panning with automatic dimensioning of lines, angles and arcs.

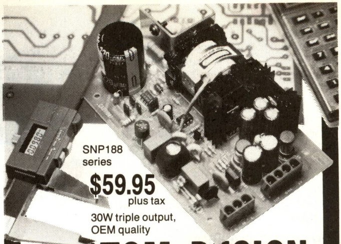
Your designs are made easy whether drawing lines, arcs, pointmarkers, polygons or ellipses. Select any of 16 pens, 256 layers, 8 line types or eleven font styles.

We accept, VISA/MASTER/BANK CARDS.

PROTEL TECHNOLOGY PTY LTD
Incorporated in Tasmania
A Member Company of Critec Corporation
TECHNOPARK: DOWSINGS POINT.
HOBART, TASMANIA AUSTRALIA. 7010
POSTAL G.P.O. BOX 536F, HOBART, 7001
TELEX: AA 58260 CRTEC

PHONE NATIONAL (002) 730100
INTERNATIONAL +6102 730100
FACSIMILE NATIONAL (002) 731871
INTERNATIONAL +6102 731871

PROTEL PT



CUSTOM DESIGN OR OFF-THE-SHELF POWER FOR YOUR PRODUCT

Name just about any application and it's likely DEWAR ELECTRONICS can provide the power supply to suit. From 30 watts through to 1000 watts – off-the-shelf or custom, in switch mode (SMPS), DC/DC and linear power. DEWAR has the power supply for your product from single to multiple output.

DEWAR offer a large range of standard off-the-shelf power supplies. Alternatively we can custom design complete to engineering sample in 30 days, and supply you production quantities in another 30.

DEWAR is the name to remember in power supplies for

- ★ **Computers**
- ★ **Industrial Controls**
- ★ **Disk Drives**
- ★ **Modems**
- ★ **Terminals**
- ★ **Telecommunications**

AND MOST PROFESSIONAL APPLICATIONS

Performance is guaranteed; our reliable and compact SMPS's are designed to meet 3.5 KV isolation with pricing to suit both small and large volume users.

DEW 200

**32-34
TAYLORS RD,
CROYDON,
VICTORIA
3136**

de DEWAR electronics PTY LTD

**TELEPHONE:
(03) 725 3333
FAX
(03) 725 6003**

High temperature cables are usually teflon coated, which is also more rugged than the PVC insulation. While toughness is an advantage, trying to strip back teflon insulation is a challenge that can try anyone's patience.

Other forms of insulation include rubber, nylon, cotton and asbestos (rather rare these days) and are used where chemicals are involved. So, leaving many things unsaid, we move now to connectors and put it altogether. (Pun intended)

Plugs and sockets

Plugs and sockets are available in many types, all designed for a specific use. In general, plugs and sockets are used to couple connecting wires, which may either carry power (AC or DC) or electronic signals. The signal wiring may have a co-axial format, or be just plain wiring, and the signals may be anything from audio to UHF signals.

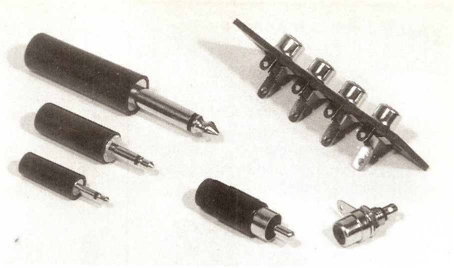
Different plugs and sockets are required for different tasks, and it is important to use the correct type to prevent signal or power losses. The pictures scattered around this article show some of the more typical plugs and sockets used within the electronics industry, and it is worthwhile to learn the names of the more common types.

Connecting power

Plugs and sockets used for connecting power carrying wires vary considerably in size, depending on how much power needs to be coupled through. If there is any resistance to the current within the plug/socket combination, heat will be developed, causing a further increase in resistance, causing more heat!

Very often, plugs and sockets designed for power applications will have a resistance specification included with a rated current and voltage capability. Typical varieties are the 'Jones' type plug/sockets, and the Molex type nylon connectors. These types come in a variety of pin configurations, and are usually polarised to prevent inadvertent reversal of the union. Various 240V plug/socket combinations abound, and the 3-pin IEC style is becoming increasingly popular.

Often a plug/socket set may have to couple signal and power wiring in the one unit. A common means of doing this is to use a so-called 'D type' subminiature connector, where the contact current rating is around 5 amps and the resistance of the union is extremely low due to the gold plated contacts. These connectors come in various sizes, including 9 pin, 15 pin, 25 pin and 50 pin configurations, with styles varying from PCB mount, direct solder types and even insulation-displacement or 'IDC' varieties.



Audio connectors, showing the popular phono plugs (left) and the RCA types.

D subminiature connectors find considerable use in digital and computer applications, but are suited to most general purpose uses. The commonly used RS232 standard for computers uses a 25 pin D plug and socket, where the plug is coded as a DB-25P and the socket a DB-25S. The letter B refers to the shell size for the 25 pin version; the 9 pin is an E size, 15 pin an A, 50 pin a D, etc.

Another means of providing a multiway connection to a PCB is with an *edge connector.* Here the PCB itself is the 'plug', in which the required tracks are brought to one edge, and spaced to mate with the female edge connector. In this case it is essential to plate the PCB tracks that form the plug with either gold (preferably) or tin plate. Various track spacings are used, and sockets are available both for single and dual sided PCBs.

Strip connectors that solder directly to the PCB are now commonly used for power supply connections, as they can be easily customised to give the required number of connections. The spacing between pins is usually fairly standard, and each pin has a square section for best contact. One problem is that often the arrangement is not polarised, and care is needed to prevent a disaster due to placing the socket onto the plug the wrong way.

Audio co-ax connectors

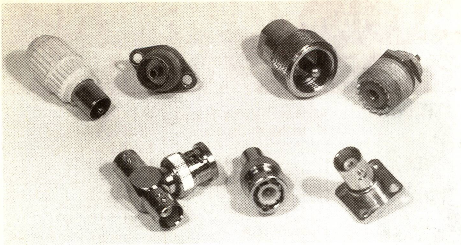
Another range of connectors are those used with co-axial style cable. For audio use, where shielded cable is employed, typical connectors are the RCA style, the DIN connector, jack (phono) plugs and Cannon connectors, to name but a few.

RCA connectors are virtually universal in their use in consumer audio applications, and the sockets are available in line, panel mount, and multiway styles. Different plating materials identify the 'cheapies' from those of better quality, with cadmium, nickel, silver alloy and gold plated types being available.

The DIN connector has long been a standard audio connector, and various pin configurations are available. The most usual is the 5 pin DIN connector, in which the centre pin is earth, and the remaining four provide a stereo input/-output configuration. The casing around the connectors can also be connected to earth to provide more shielding if needed. The Reference Data sheet included elsewhere in this issue shows the 5-pin DIN connector in its audio and its MIDI roles.

Another fundamental audio connector is the 'jack' type. These connectors are also known as phono connectors, and come in 3 sizes: 2.5mm, 3.5mm and 6.5mm. Mono and stereo types are available (although it may be hard to get stereo in the 2.5mm size), and are typically used for microphone or headphone connections as well as signal coupling.

The phono socket has one feature not usually found on other connectors, in that it has a contact arrangement whereby inserting the plug causes a contact to open within the socket, disconnecting a section of the circuit. Use is made of this in an earphone socket, where plugging in the earphone disconnects the speaker.



RF connectors. Top left shows the types used for TV antenna connections, top right the PL-259 plug and the SO-239 socket. Underneath are examples of the BNC range of connectors.

Other audio connectors include the Cannon range, which are generally used in professional quality sound installations. There are various styles within the range, although the 3-pin type is the most common.

A 240V AC Cannon style connector is also available, with a panel mount socket being employed to connect with a 3-pin line plug. Further brands include the Amphenol range with their almost unlimited variety of contact configurations, along with many others too numerous to mention.

RF connectors

Connectors designed for RF applications are numerous, each with its own particular advantage. The main difference between an audio connector and an RF connector is the material used to insulate the centre (or active) pin from the earth shield. Radio frequencies will often be bypassed to earth in ordinary audio connectors, although it is usually fairly difficult to fit co-axial cable to a connector designed for shielded cable anyway.

A commonly used RF connector is one not unlike the RCA connector. It is called by various names, including a co-axial, an RF, 'Belling-Lee' or a TV connector. We will refer to it as a co-axial connector, as most parts suppliers seem to use this name. These connectors come in various styles including panel mounting, line connectors, plastic or metal case varieties, etc. These are typically used in TV applications, such as connecting a TV antenna to a VCR, TV set and so on.

Another very popular connector used for RF work is the BNC connector. The main difference between this connector and the co-axial type is the manner in which the coupling is arranged. In the co-axial connector, the connection is a push fit, whereas the BNC style has a bayonet type fitting. This, along with appropriate clamping of the cable to the connector provides a more robust coupling.

Many test instruments, particularly oscilloscopes, use the BNC connector for connecting test leads. A wide range of BNC style connectors are available, including a 3-way T piece, adaptors between connector types, and various mounting styles. The BNC connector is useful for all 'co-ax' type connections, including audio through to UHF. The only limitation is the physical size of the co-axial cable that can be attached; usually up to a limit of 5mm OD.

Another common connector, used in much the same way as the BNC type is the so-called 'UHF' connector. Again there are various names for these connectors, including the PL-259 (plug) and the SO-239 (socket) or even the 'M' connector. These have a threaded coupling arrangement, which gives a reasonably weatherproof connection.

These connectors find use in CB radio applications as antenna connectors, or even as test lead connectors. A wide variety of configurations exist in these connectors, including a BNC to UHF adaptor, Tee pieces, right angles, panel mount, and so on.

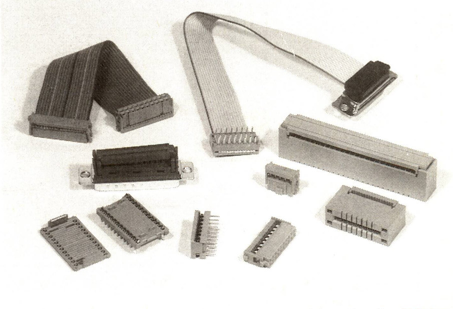
Miscellaneous connectors

Other connectors are those used for car radio antennas, test leads, 300 ohm TV ribbon, and various other applications. Connectors that qualify as miscellaneous include terminal strips, terminal posts and spade connectors. There are also many specialised connectors, such as the popular 'Centronics' or 57N36-type connector, as well as other types that different manufacturers have developed for their products.

Test leads, such as those used with a multimeter, usually have a 4mm plug to mate with the meter socket. The banana plug is one variety of plug used in this application. Spade connector lugs are used to connect single wires, and are often used where high currents are flowing in the connection.

The Centronics or 57N36 plug is designed for use with the Centronics

Continued to page 144



IDC connectors. Connection is simply a matter of inserting the IDC type ribbon cable and compressing the fitting to its clamped position. A wide range of IDC connectors are available.

OBIAT PTY LTD YOUR ONE S
TEST & MEASUR

Fluke 70Series Multimeters

73

- Analog Bar Graph
- 3200 count Display
- 0.7% basic dc accuracy
- 10A range
- Autoranging only
- 3 year warranty

75 adds

- 0.5% accuracy
- Autoranging with range hold
- 10A + autoranged mA ranges
- Continuity & diode test beeper

77 adds

- 0.3% accuracy
- Touch Hold™ function

Model	*Inc Tax*	*Ex Tax*
73	$192	$167
75	$266	$232
77	$339	$295

Fluke 20 Series Multimeters

21

- Safety Yellow case
- Fluke 75 features but less 10A range

23

- Safety Yellow case
- Fluke 77 features + fused 10A input

25

- Charcoal or yellow case
- Analog/Digital display
- 0.1% basic dc accuracy
- 100μV to 1000V ac & dc
- 0.1μA to 10A all fused
- -15°C to +55°C operation
- Touch Hold™ function
- Two year warranty

27

- As 25 but adds
- Relative (difference) mode
- Min/Max recording mode

Model	*Inc Tax*	*Ex Tax*
21	$247	$215
23	$362	$236
25	$569	$495
27	$655	$570

NEW 80 Series Multimeters

- Min/Max/Average recording stores highest, lowest and true average of all readings
- Selectable response time to record turn-on surges or drift etc
- 1ms peak Min/Max hold on 87 to capture elusive transients or half-sine surges to 400Hz
- Audible Min/Max Alert™ signals readings above or below previous limits

83

- Volts, Amps, Ohms, diode test, continuity, frequency and duty cycle, capacitance, Touch Hold™, relative, protective holster
- 0.3% basic dc accuracy
- 5kHz Vac
- Analog bargraph with zoom
- 3 year warranty

85 adds

- 0.1% accuracy
- 20kHz Vac

87 adds

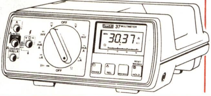
- High resolution analog pointer
- True rms ac
- 1ms peak Min/Max
- 4 1/2 digit mode
- Back lit display

Model	*Inc Tax*	*Ex Tax*
83	$530	$461
85	$615	$535
87	$726	$632

Fluke 37 Bench Portable Multimeter

- 3200 count display plus analog bar graph
- Min/Max and Relative modes
- Touch Hold ™ function
- 0.1% basic Accuracy
- Built-in storage compartment for leads etc
- EMI shielded

Model	*Inc Tax*	*Ex Tax*
37	$563	$490



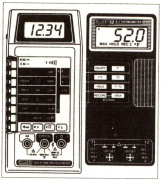
Fluke 8060A Hand Held Multimeter

- 0.04% basic accuracy
- 19999 count display
- True rms ac volts and current
- Continuity & diode test
- Frequency measurement
- dBm, relative dB
- Relative reference
- One year calibration cycle and Warranty

Fluke 8062A

- 0.05% basic dc accuracy
- True rms ac voltage and current
- Continuity and diode test
- Relative reference
- One year calibration cycle and Warranty

Model	*Inc Tax*	*Ex Tax*
8062A	$782	$680
8060A	$925	$805



50 Series Thermometers

Measurement Ranges

51

- K-Type: -200°C to +1370°C
- J-Type: -200°C to +760°C
- 0.1% basic accuracy
- °C/°F selectable
- Hold Mode
- Standard mini-connector input
- 1200hour 9V battery life
- 3 year Warranty
- One K-type bead thermocouple included

52 as above but adds

- Dual thermocouple operation
- Scan, differential and Min/Max recording
- Two K-type thermocouples included

Model	*Inc Tax*	*Ex Tax*
51	$304	$265
52	$419	$365

Goldstar 'Shirt Pocket' Multimeters

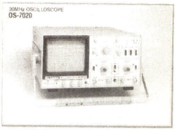
- 3 1/2 digit LCD display
- Autoranging
- Overload protection
- Diode & Continuity checking
- Beeper
- Low battery & Overrange indication
- 10MΩ input impedance
- Memory Mode for relative measurements (DM6235 & DM6335)
- Extended resolution (DM6235 & DM6335)
- Hold Function (DM6335)
- Automatic current limiting

Model	*Inc Tax*	*Ex Tax*
DM6135	$88.80	$74
DM6235	$99.60	$83
DM6335	$118.80	$99

Goldstar Bench Portable Multimeter

- 4 1/2 digit, 10A, AC/DC Data Hold

Model	*Inc Tax*	*Ex Tax*
DM7241	$294	$245



Goldstar 20MHz & 40MHz Oscilloscopes

20MHz OS7020

- Variable Sweep Control with x10 magnifier
- Uncal warning lights
- Trigger Indicator LED
- TV-V & TV-H Triggering
- Trigger Hold-Off
- 1mV/div max sensitivity
- Professional tilt handle
- One year warranty
- Probes included

40MHz OS7040

- Delayed sweep function
- 1mV/div sensitivity
- TV-V & TV-H triggering
- High sensitivity X-Y mode for phase measurements
- Timebase A 0.2μS to 0.2S in 19 calibrated steps
- Timebase B 0.2μS to 20μS in 7 calibrated steps
- Probes included

Model	*Inc Tax*	*Ex Tax*
OS7020	$858	$740
OS7040	$1334	$1150

Full Range of Multimeter Accessories Available

Here are just a few of the accessories available from Fluke

Y8101
1 to 150A ac clamp-on current probe

Y8100
Dual range 10A/200A Hall Effect clamp-on current probe

80i-400
1 to 400A ac clamp-on current probe

80i-410
5 to 400A Hall Effect ac/dc clamp-on current probe

80i-600
1 to 600A ac clamp-on current probe

80i-1010
1 to 1000A Hall Effect ac/dc clamp-on current probe

80k6
6000V dc or peak ac voltage probe

80k-40
40kV dc or 28kV rms ac voltage probe

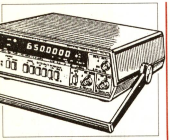
85RF
AC voltage probe from 100kHz to 500MHz

80T-150U
Universal temperature probe

80TK
Type K thermocouple module for use with interhangeable probes

Call us with your requirements

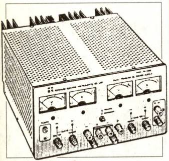
OP DISTRIBUTOR OF
G INSTRUMENTS



Topward Counters

- All feature Ch-A and Ch-B. TFC1214 and TFC1217 also have Ch-C.
- Frequency Range 5Hz to 100MHz, to 650MHz, to 1200MHz.
- Accuracy ±(1 count+time base accuracy).
- Period Measurement (Ch-A) 0.04μS to 0.2S.
- Multiplier x1, x10, x100, x1k
- Resolution 0.01nS to 0.1μS
- Totalise (Ch-A) to 99999999max. Frequency 5Hz to 10MHz
- Input Sensitivity: Ch-A 25mVrms (80MHz), 35mVrms (100MHz)
  Ch-B 25mVrms
  Ch-C TFC1214 20mVrms (650MHz)
  TFC1217 25mVrms (1000MHz) and 40mVrms (1200MHz)
- Input Impedance Ch-A, Ch-B 1MΩ/100pF; Ch-C 50Ω
- Ch-A Attenuator 1, 1/10

Model	***Inc Tax***	***Ex Tax***
TFC1211	$520	$450
TFC1214	$760	$655
TFC1217	$910	$785



Topward Regulated DC Power Supplies

- Ripple & Noise CV 0.5mVrms or 4mVp-p; CC 0.5mArms or 4mAp-p
- Line Regulation CV 0.02% +2mV; CC 0.02%+250μA
- Load regulation CV 0.02% +2mV; CC 0.02%+500μA
- Output Impedance 5mΩ+2μH
- TPS4000 Series only
  Tracking Error ±(0.2%+5mV)
  5V/3A Output (4303)
  Voltage 5V±5%; Current 3A max
  Ripple 2mVrms
  Regulation 0.1%+5mV

Model	***V/A***	***Inc Tax***	***Ex Tax***
2302	30V/2A	$360	$310
23010	30V/10A	$1032	$890
2303	30V/3A	$389	$335
4303	±30V/3A 5V/3A	$759	$650
4306	±30V/6A	$957	$825
4603	±60V/3A	$1154	$995

Metrix 40 Series 4000 Count Multimeters

- Four Year Warranty
- 2.5 readings per second
- Auto-Ranging with manual range switching
- Memory Function to Hold measured value
- Max Function to hold a maximum value
- Patented lead locking system
- Meets IEC 348 Class II safety standards
- Suits harsh environments - water, shocks etc
- True RMS Measurement (MX-47)
- Temperature Measurement with K-type theromocouple (MX-47)
- Vac & Vdc from 400mV to 1000Vdc/750Vac
- Idc & Iac from 400μA to 10A
- Resistance 400Ω to 20MΩ
- Max resolution 100μV/0.1μA/0.1Ω

MX-41
Autoranging with manual ranging. Fused 10A range, Memory, Peak Hold, Beeper, 0.5% basic accuracy, 4 year Warranty

MX-43 Adds Waterproofing and 0.3% accuracy

MX-45 Accuracy improved to 0.1%

MX-47 Adds True RMS & Temperature

Model	***Inc Tax***	***Ex Tax***
MX-41	$283	$249
MX-43	$324	$285
MX-45	$507	$445
MX-47	$564	$495

Metrix MX-579 Bench Multimeter

- 4 1/2 digits
- Bright 20mm LED Display
- Selectable true rms measurements (AC or AC+DC)
- Bandwidth to 200kHz (2dB)
- dB Measurements
- Optional IEEE Interface (M579A-1)
- Double Insulated
- Fused 10A range

Model	***Inc Tax***	***Ex Tax***
MX579	$1020	$895
MX579A-1	$1989	$1745

Metrix MX1200S Clamp-On Multimeter

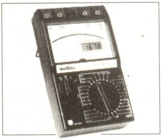
- Eight Functions
- DC & AC Current to 1000A true rms
- DC & AC Voltage to 750V trms
- Active Power to 199.9kW trms
- Apparent Power to 199.9kVA trms
- Power Factor 0.3cap...1...0.3ind
- Frequency to 1000Hz
- Analog Output for recorder or scope
- Autoranging
- Surge Current Measurement (Peak Hold)

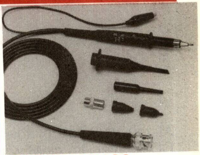
Model	***Inc Tax***	***Ex Tax***
MX1200S	$1077	$945

Metrix MX573 True Analog & Digital Multimeter

- True rms AC measurements
- 8 Functions with 35 ranges
- 10MΩ input impedance for Vdc
- Auto-polarity switching
- 25kHz bandwidth
- Overload protected
- Safety in use
- Continuity Beeper
- Digital Readings
  0.1% accuracy
  2000 Count display
  High contrast LCD display
- Analog Readings
  Linear scale with 25% overrange
  Taut Band Movement
  20mV and 200μA ac and dc ranges

Model	***Inc Tax***	***Ex Tax***
MX573	$837	$735





COLINE SP100 OSCILLOSCOPE PROBES

x10 POSITION
Attenuation Ratio: 10:1
Bandwidth: DC-100MHz
Rise Time: 3.5nS
Input Capacitance: Nominal 16pF.
Compensating Range: 10-60pF.
REF POSITION
Probe tip grounded via 9MΩ resistor, oscilloscope input grounded.
x1 POSITION
Attenuation Ratio: 1:1
Bandwidth: DC-10MHz
Rise Time: 35nS

COLINE M12SW SWITCHED PROBE

x10 POSITION
Attenuation Ratio: 10:1
Bandwidth: DC-250MHz
Rise Time: 1.4nS
Input Capacitance Nominal 18pF.
Compensating Range: 10-60pF.
x1 POSITION
Attenuation Ratio: 1:1
Bandwidth: DC-10MHz
Rise Time: 35nS
Common Specs
Input Resistance: 10MΩ when used with oscilloscopes which have 1MΩ output. (Probe resistance 9MΩ ±1%)
Input Capacitance: 55pF. + Scope Input
Input Resistance: 1MΩ (Oscilloscope Input)
Maximum Input Voltage: 600V DC including peak AC derating with frequency.

COLINE TLS 2000 TEST LEADS

A high quality test lead set suitable for use with analog or digital multimeters. The leads are flexible copper conductors with a tough silicone rubber sheath and terminated with 4mm safety plugs.
Maximum Working Voltage: 1000Volts
Maximum Current: 10 Amps
UL Listed File No. E79581

Model	***Inc Tax***	***Ex Tax***
SP100	$47	$41
M12SW	$72	$62
TLS2000	$47	$41

Detailed brochures and full specifications are available on all these products. Call us for specialist technical advice

OBIAT PTY. LTD.

(Incorporated in N.S.W.)
129 Queen Street, Beaconsfield
P.O.Box 37 Beaconsfield NSW 2014
Tel : (02) 698 4776 Telex : AA71958 Fax : (02) 699 9170

bankcard
welcome here
MasterCard

Hifi Equipment Review:

Technics SL-P1200 'Pro' CD Player

At the very top of the Technics range, the model SL-P1200 CD player is clearly intended for professional rather than domestic use. With a distinctive and rugged physical 'console' design, it offers not only exemplary performance, but features simply not found on most other models.

We first became aware of the Technics SL-P1200 some months ago, when it was featured in the firm's latest catalog. It looked so interesting that we immediately decided to see if we could get one for review, so that we could check it out on your behalf (magnanimous, aren't we?).

The trouble was that there were only a couple of samples in Australia, and apparently half of the country's radio stations had already asked to check them out too. So we had to be patient for a while, until one finally became available.

I gather the radio stations have been very impressed, and when the sample unit arrived it didn't take long to find out why. The SL-P1200 is certainly a most impressive machine – but I'm getting ahead of myself. Let's start at the start, with a basic description of the machine and its facilities.

First of all, it's BIG. At 430 x 380 x 165mm, including mounting feet, it's considerably bigger than most CD players. In fact it's larger than many domestic hifi amplifiers. And with a weight of about 15kg it's heavier than most, too.

Frankly it looks to have been designed and built like a battleship, with the emphasis on ruggedness and reliability under the heaviest use. I wouldn't be surprised if this is one of the things that made the radio stations enthusiastic, because so many of the newer generation of CD players seem to be relatively flimsy, and hardly suitable for day-to-day use.

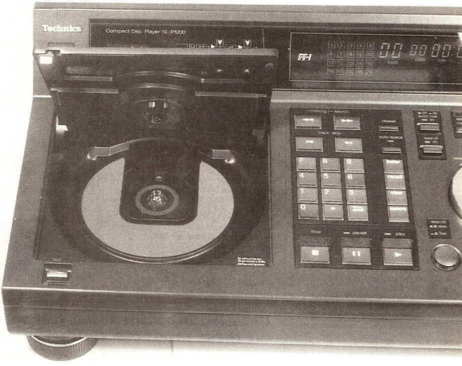
The next thing you notice is that its physical format is rather different from most others. Unlike the now almost universal rectangular box with roll-out disc drawer on the front, the SL-P1200 is shaped like a miniature version of a professional mixing console. The emphasis is on convenient desk-top operation, with a gently sloping horizontal control panel and a more steeply sloping display panel further back.

There's no roll-out disc drawer, but instead a little swing-up door to the left of the controls, with a glass window. The door swings up when you press a button, revealing something which looks like a conventional turntable. You then simply pop the disc onto the central spindle, and shut the door again – convenient and foolproof, and with far less to go wrong than with fancy motorised drawer mechanisms. Why aren't more CD players made this way?

Incidentally when there's a disc inside, there's an interlock which prevents the door from opening unless you've pressed the 'Stop' button to stop the motor and disable the laser. So there's no danger of accidental eye damage.

The basic controls for the SL-P1200 are much the same as most other CD players, with the usual track select, skip and programming buttons. The same applies to the basic display facilities, showing the number of tracks on the CD, the track currently playing and the elapsed time. But with this player that's really just the start.

For example, you can press a button and have the time display change from



No fancy roll-out trays – just a sturdy door that swings up, to let you drop a disc onto the spindle and retrieve it afterwards.

Very solidly built, the SL-P1200 is obviously intended for heavy-duty professional use.

'time elapsed' to 'time remaining' mode – very handy for discos, I imagine, as well as radio stations. Particularly as the display shows *tenths* of a second, as well as the usual minutes and seconds.

You can also press a button and override the normal speed servo, adjusting replay speed manually over a significant range (approximately +/− 8.5%) using a slider control. This would obviously be very useful for making minor adjustments to pitch or overall playing time, and also for fine control over CD sound effects which must be matched to visuals during sound track assembly for a film or video production.

In addition the SL-P1200 provides a two-speed search knob, to allow precise selection of any given spot on a disc track – in 3-frame increments. So its cueing facilities are basically excellent.

Other little niceties include indication of whether the disc being played uses emphasis or not; display of both track and index numbers; output of frame numbers from a special socket on the back, for connection to automatic mixing and cueing systems; and a wireless remote control – which wasn't supplied with the unit sent for review, but apparently it provides digital volume control as well as the usual control functions.

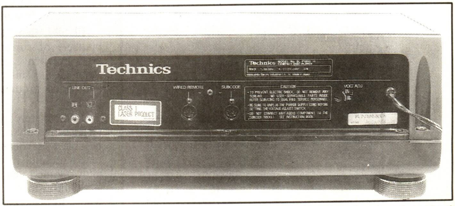
There's also a monitoring jack for stereo headphones, with its own slider control, although this didn't actually work on the sample unit. Perhaps it had been a casualty during the unit's travels around the radio stations.

So much for the facilities – but what about the performance specs? Here again we were slightly behind the 8-ball, because the sample unit seemed to have become separated from its operating manual. All we had to go on was the brief spec given in the Technics catalog previously mentioned, although this is quite helpful.

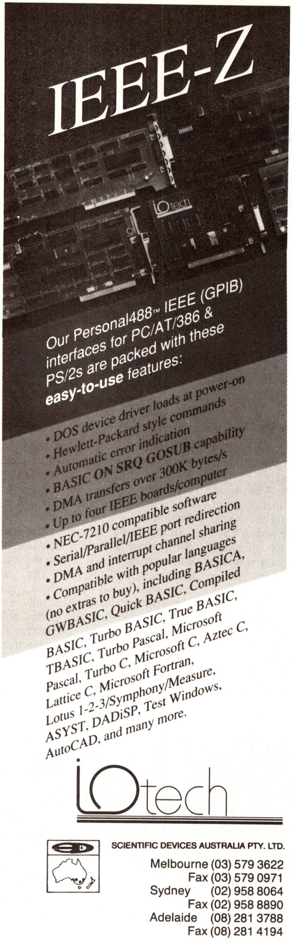
It does appear that the SL-P1200 has the desirable twin high-speed D/A converters for phase linearity, with a 2x oversampling digital filter. It also features Technics' 'Class AA' circuitry in the sample and hold sections of the D/A converters, allowing faster and more accurate charging/discharging of the sampling capacitors, for improved glitch suppression. Class AA stages are also used for the player's line output buffer amplifiers, for lower distortion.

(Basically the Technics Class AA amplifier consists of separate voltage and current stages, both driving the load via a bridge configuration. The current stage supplies all of the load's current requirements, leaving the voltage stage virtually unloaded and better able to control its voltage. This is claimed to allow higher linearity with reactive and non-linear loads.)

Like the other CD players in the current Technics lineup the SL-P1200 ap-



Rear view of the player, showing the wired remote input and subcode output connectors.


IEEE-Z

Our Personal488™ IEEE (GPIB) interfaces for PC/AT/386 & PS/2s are packed with these **easy-to-use** features:

- DOS device driver loads at power-on
- Hewlett-Packard style commands
- Automatic error indication
- **BASIC ON SRQ GOSUB capability**
- DMA transfers over 300K bytes/s
- Up to four IEEE boards/computer
- NEC-7210 compatible software
- Serial/Parallel/IEEE port redirection
- DMA and interrupt channel sharing
- Compatible with popular languages (no extras to buy), including BASICA, GWBASIC, Quick BASIC, Compiled BASIC, Turbo BASIC, True BASIC, TBASIC, Turbo Pascal, Microsoft Pascal, Turbo C, Microsoft C, Aztec C, Lattice C, Microsoft Fortran, Lotus 1-2-3/Symphony/Measure, ASYST, DADiSP, Test Windows, AutoCAD, and many more.

IOtech

SCIENTIFIC DEVICES AUSTRALIA PTY. LTD.

Melbourne (03) 579 3622
Fax (03) 579 0971
Sydney (02) 958 8064
Fax (02) 958 8890
Adelaide (08) 281 3788
Fax (08) 281 4194

Technics SL-P1200 'Pro' CD Player

parently uses a linear motor system for laser tracking across the disc, with a low-friction carriage assembly. The laser optics also apparently use a dual aspheric glass lens, said to provide superior focusing and temperature stability as well as greater scratch resistance than plastic lenses.

What we found

Not surprisingly, when we put the sample unit through its paces the results were very impressive – despité the fact that it had obviously seen a fair bit of use already.

Using both the Denon and Philips No.3 test discs, the frequency response was flat within 0.2dB from 20Hz to 20kHz – very smooth indeed. Sweep tracks also revealed very low aliasing levels, although possibly not quite as low as with 4x oversampling filters.

The harmonic distortion, intermodulation distortion and noise levels were also very low, below the measurement floor of our test gear. And of course the wow and flutter were effectively non-existent.

Stereo phasing was also very good, the two channels being within 4° over the full range with even this error coming in only slowly and smoothly above 10kHz.

Square wave response was very clean, with overshoot limited to about 11% and ringing well damped. The same comments applied to impulse response, as you might expect.

Tone burst response was also very clean, with only a slight amount of ringing evident at the trailing end of the bursts. In short, on the audio side the SL-P1200's performance proved to be very close to exemplary.

Its disc tracking performance was also excellent. It sailed right through all of the 'horror stretch' tracks on the Philips 5A test disc, with their demanding man-made hurdles, without any trace of mistracking or audio degradation. In fact it was so good that I had to stop the disc and make sure I hadn't put on the fault-free number 5 reference disc, by mistake!

But I hadn't made any mistake. It simply played the 'nasty' 5A version just as easily as the 5 version, without a murmur. Track breaks up to 900um long, black dots up to 800um in diameter, artificial fingerprints and all – no problem!

And how did it sound in the listening tests? In a word, excellent. After quite lengthy tests with my collection of known reference CDs, my impression is that it can deliver very close to whatever is stored on the disc.

All told, then, the SL-P1200 seems to be very close to the pinnacle of current CD player technology, combining as it does excellent performance and rugged reliability. It would seem ideally suited for professional use in radio stations, film and video production studios and other demanding applications.

Unfortunately the price is rather high, at a cool $3999 (RRP). So only a handful of really well-off hifi enthusiasts will be able to savour its delights directly. Which makes me particularly grateful to the National Panasonic/Technics people, for allowing me to check out the sample on your behalf!

Should you be in the happy position of wanting to know where to place an order, National Panasonic/Technics' address is at 95-99 Epping Road, North Ryde 2113 – or 'phone (02) 886 0200. (J.R.)

WOOD FOR CHIPS ... WOOD FOR CHIPS ... WOOD FOR CHIPS ... WOOD FOR CHIPS ... WOOD FOR CHIPS ... WOOD FOR CHIPS ... WOOD FOR C

NEW - National Semiconductor Data Books

The latest editions (1988) just received. Hurry because they never last!

Interface contains all you could possibly require on:

- Transmission Line Drivers and Receivers
- Bus Transceivers
- Peripheral Power Drivers
- Display Drivers
- Memory Support
- Microprocessor Support
- Level Translators and Buffers
- Frequency Synthesis

Plus Heaps of Application Notes
only **$15.00**

Data Communications, Local Area Networks, UARTs Handbook

More information on

- Local Area Networks (IEEE 802.3)
- High Speed Serial Data Communications
- UART's
- Transmission Line Drivers and Receivers

And Heaps of Application Notes
only **$10.00**

Graphics Handbook

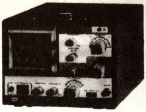
This slim volume will become the reference for anyone using National's Advanced Graphics Chipset. It has full details on Advanced Graphics Chipset Plus Application Notes
only **$10.00**

Microcontrollers Databook
Practical Solutions to Real Problems

Now you can get all the information you need on the National Semiconductor range of microcontrollers. These generally are suited for high volume use and cover 4, 8 and 16 bit controllers. This manual covers the full range and also includes data and an excellent application note on National's MICROWIRE™ range of peripheral chips.

- COP400 & COP800
- HPC™
- MICROWIRE™ and MICROWIRE/PLUS™
- Display/Terminal Management Processor (TMP)
- Microprocessor Development Support

only **$17.50**



NEW LOW COST OSCILLOSCOPE

This year we have added an economical oscilloscope from our friends at GoodWill, the **GOS-3310.**

Features

- 10MHz, single channel
- CRT Size: 75mm
- Sensitivity: 5mV/div to 5V/div, DC to 10MHz
- Timebase: 10mS/div to 0.1µS/div
- Sweep: Auto and Normal
- X-Y Operation

GOS-3310 **$457.40**

UNINTERRUPTIBLE POWER SUPPLIES

Two models to choose from both feature integral re-chargeable batteries, power failure alarm and status indicators.

Approximately 412mm Wide x 80mm High x 370mm Deep

UPS-350, 350 Watts Square Wave **$754.00**

UPS-501, 500 Watts Square Wave **$841.00**

NEW VARIABLE POWER RESISTORS

PRN-553 Series

- 320W Continuous
- 640W 15 minutes
- 1280W 4 minutes
- 800V DC 750V RMS

33 ohm **$166.20**

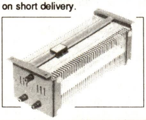
Other resistance values from 1 ohm to 300 ohm available on short delivery.

PRN-800 Series

- 640w Continuous
- 1280W 15 minutes
- 800V DC 750V RMS

106 ohm **$174.90**

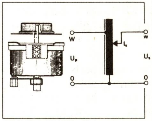
Other resistance values from 0.5 ohm to 500 ohm available on short delivery.



NEW VARIABLE TRANSFORMERS

We have previously advertised the closed version of these transformers, but we now stock the panel mount variety in two sizes. Other sizes up to 26A are available to special order on short lead times.

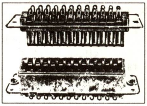
HSG-0022 0-250V 0-1.2A **$94.00**
HSG-0052 0-250V 0-2.52A **$118.00**



Heavy Duty Connector

Woody won't tell us how he does it but here's another super connector special.

- 24 Pin polarised plugs and sockets.
- Chassis Mounting.
- Genuine gold plated contacts.
- Full 5 amp rating.



Dimensions

Panel Cutout 65mm x 20mm

Mounting Holes M3 clearance on 73mm centres

	Plugs	Sockets
Height	81.8mm	81.8mm
Width	22.2mm	22.2mm
Depth	24.6mm	22.7mm

You could pay over $25.00 each for these little beauties, but Geoff said to clear them at a measly unit price of **$9.50**

But, as they say on the box, that's not all!

C65.M 6.5mm Panel Mount Mono Socket
were $1.40 now **$0.50**

PCB Mount "D" Connectors
D-15-PLG-RA Metal Shell
were $4.00 now **$2.00**
D-25-PLG-STR Metal Shell
were $4.50 now **$2.00**

EDGE CONNECTORS

	Were	Now
2 x 36 - 0.1in wire wrap	$14.60	**$7.30**
2 x 30 - 0.1in wire wrap	$12.70	**$6.35**
1 x 48 - 0.1in wire wrap	$8.00	**$4.00**
2 x 50 - 0.125in PCB	$15.95	**$8.00**
2 x 40 - 0.125in W/W	$15.95	**$7.50**
2 x 40 - 0.125in R/A PCB	$15.95	**$7.50**
1 x 8 - 0.156in Solder	$2.40	**$1.20**
1 x 10 - 0.156in Solder	$3.75	**$1.90**
1 x 15 - 0.156in Solder	$4.65	**$2.40**
2 x 43 - 0.156in W/W	$17.05	**$8.50**

CHIPS, CHIPS, CHIPS

Others claim to be No 1 in semis(or is that no-one) but we all know it's ***Wood for Chips****, so we have taken the axe to this selection of semiconductor specials. If he keeps giving stuff away like this the accountant will take the axe to Woody, so better get in for your chop now.*

2N2160 Unijunction was $1.10 now only **$0.65**
2N2904A PNP 60V 600mA was $1.45 now only **$0.70**
2N4403 PNP 40V 600mA was $0.30 now 10 for **$1.50**
2N5401 PNP GPA was $1.90 now only **$0.50**
2N5485 NFET 25V 10mA was $0.80 now only **$0.40**
2N5550 NPN GPA was $0.30 now only **$0.15**
BD646 PNP D/ton 60V was $1.40 now only **$1.00**
LM311H TO5 Comparator was $0.55 now 10 for **$1.00**
MRF208 RF 225MHz 10W was $3.50 now only **$1.50**
PN3565 NPN 30V 150mA was $0.25 now 10 for **$1.00**
PN3566 NPN 60V 150mA was $0.25 now 10 for **$1.00**
PN3567 NPN 80V 150mA was $0.25 now 10 for **$1.00**
PN3569 NPN 60V 150mA was $0.25 now 10 for **$1.00**
PN3641 NPN 60V 500mA was $0.25 now 10 for **$1.00**
PN3642 NPN 60V 500mA was $0.25 now 10 for **$1.00**
TSB3055 NPN 60V 15A was $3.00 now only **$1.00**

Three Super Semiconductor Specials

2N6706 NPN TO92+ 45V was $1.00 now 10 for **$2.00**
2N6710 NPN TO92+ 80V was $1.10 now 10 for **$4.00**
PN3643 NPN 60V 500mA was $0.25 now 100 for **$6.00**

GEOFF WOOD ELECTRONICS

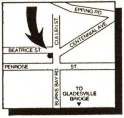
GEOFF WOOD ELECTRONICS PTY LTD

229 Burns Bay Road, (Corner Beatrice St.) INC IN NSW
Lane Cove West, N.S.W. P.O. Box 671, Lane Cove N.S.W. 2066
Telephone: (02) 427 1676, Fax: (02) 428 5198.
8.30am to 5.00pm Monday to Friday, 8.30am to 12 noon Saturday.
Mail Orders add *$5.00* to cover postal charges.
Next day delivery in Sydney add $5.00.

All prices INCLUDE sales tax.

Tax exemption certificates accepted if line value exceeds $10.00.

BANKCARD, MASTERCARD, VISA, CHEQUES OR CASH CHEERFULLY ACCEPTED



SUPPORT WORLD WILDLIFE FUND AUSTRALIA

... WOOD FOR CHIPS ... WOOD FOR CHIPS ... WOOD FOR CHIPS ... WOOD FOR CHIPS ... WOOD FOR CHIPS ... WOOD FOR CHIPS ... WOOD FOR CHIPS ... WOOD FOR CHIPS ... WOOD FOR CHIPS ...

WOOD FOR CHIPS ... WOOD FOR CHIPS ... WOOD FOR CHIPS ... WOOD FOR CHIPS ... WOOD FOR CHIPS ... WOOD FOR CHIPS ... WOOD FOR CHIPS ... WOOD FOR CHIPS ...

The Serviceman

You scratch my back...

This month I have two quite different stories for you. The moral of the first story is 'Do unto others...' and points out that even commercial competitors can still be friends and help each other. The other one is about jobs involving valves remember them?).

One of the most useful things a television technician (or any other technician for that matter) can do is to keep on good terms with his colleagues – even those who are his commercial opposition. This was never more clearly shown than in a recent exchange of information between one of my friends and I over the last week.

I found myself faced with a baulky Blaupunkt television, in the customer's home. I tried everything I could think of and kept going round in circles. The pensioner owner sat in the kitchen, drumming her fingers on the table and worrying about the eventual size of my bill.

In the end, I swallowed my pride and asked if I could use the phone. I rang my colleague, who specialises in German TV's, and put the problem to him. His response was immediate and he nominated the exact transformer pin that would be dry-jointed. He was right, of course, but I could never admit to my own ignorance.

I went off home, grateful for the help I had received and determined that I would reciprocate whenever the opportunity arose. It came only a week later.

My friend rang with the heartfelt plea – can you help me? It seems that he had an English GEC set, model C2213-A, on the bench and it had given him more aggro than any set is entitled to give.

It was in for 'NO GO' and had already presented an open circuit feed resistor to the chopper control IC, and a shorted chopper transistor. After repairing these faults, my friend had a working set, but one suffering from bad retrace lines and a loud screech from somewhere inside the hardware.

Mindful of the assistance he had rendered to me a week earlier, he rang me with a plea for help. I have had more experience with this chassis than he has and I had a copy of the service manual – plus a box of spare boards and odd parts for the model. In a way, I was able to help him, but indirectly I caused him to make a very expensive mistake.

'Retrace lines' are a fairly common fault in most sets. They are the image of the CRT beam as it returns to the top of the screen, at the end of each field of the picture.

There are two causes of this fault. One is failure of the vertical blanking pulse (which normally blanks off the lines), and the other is an excessive screen voltage which keeps the tube face illuminated even when the picture information is blanked.

I have had this problem before in GEC's. It is commonly the over-voltage effect, when R604 in the screen supply network goes open circuit. I told my friend of my previous experience, and nominated the particular resistor.

Unfortunately, the resistor is out of reach in the chassis unless the line output board is removed, and this requires that the lead from the output transformer overwind to the tripler be unsoldered. My friend didn't realise this, and in his attempts to get the board out of the chassis, he ripped the overwind lead off the transformer.

He was somewhat upset over the need to buy a new transformer, but that was the only option available to him.

In due course the new transformer was fitted, the screen resistor was checked (and replaced anyway), and the set fired up again.

After all this, it was in exactly the same condition as it been earlier. Not surprisingly, he wasn't in a very happy frame of mind when he rang me and asked if I would take over the job.

When the set arrived in my workshop, I had to agree that the retrace lines and the screech were quite intolerable. Although the noise was so loud as to be almost painful, I decided to tackle the retrace lines first.

The GEC does not have an overall screen adjustment, as in so many other sets. In this one, the strongest colour has to be set to cutoff, then the others are adjusted to balance. Except that in this case there was no way I could get any of the guns down to cutoff.

I checked all the resistors and all of the capacitors in the screen voltage network, but could find nothing wrong. The manual does not give a specific voltage for the picture tube screens, but the figure I found seemed to be somewhat higher than the equivalent values in comparable sets.

I wanted a lower voltage for the screens, but there seemed to be no way of procuring the desired result with the specified set of component values.

I considered the possibility that the new transformer was delivering a higher screen voltage than the older unit, but this was unlikely because the set had suffered from retrace lines even before the new transformer had been fitted.

Eventually, I elected to change some of the resistor values, to see if I could reduce the screen voltages to a figure that would allow the guns to be adjusted down to cutoff.

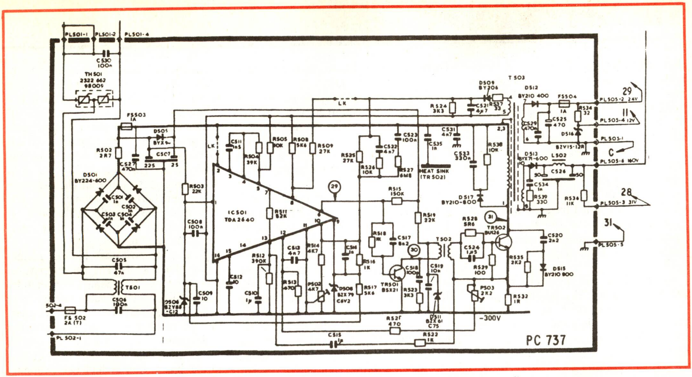
The first resistor to be changed was R604, on the grounds that this one is the one that most usually causes retrace troubles. My reasoning went something like this:

R604 is normally 150k ohms, and the trouble appears if this goes high or open. So, if R604 is the correct value, but gives the effect of being high, what would happen if I lowered its resistance?

An experiment like this was no sooner thought of than it was done. Using a decade resistance box, I very soon had a 100k ohm resistor clipped across R604. This was too much, as now I had a dark screen and could get barely any brightness at all.

Next I tried a 470k ohm resistor and this was better, allowing some darkening of the retrace lines but was still not a complete cure. I finally settled on another 150k resistor, in parallel with R604. The combined resistance was 75k ohms, and this seemed to be the required value.

After this, I could set the guns to cutoff and get a near perfect picture, with



The power supply circuit of the GEC C2213 set, which forms the subject of this month's first story.

no trace of the lines that had been so troublesome up to this point.

All that remained was to cure the terrible screech that had made my ears ring, and had kept the family out of the workshop ever since the set came in.

There was one symptom, so far unmentioned, that seemed to point to a possible solution to the problem. It was a very fine serration on all vertical lines in the picture. This type of fault usually occurs when the horizontal oscillator is running rough, or 'squegging', but the effect is commonly much harsher than was apparent in this case.

Squegging is the result of out-of-phase line frequency feedback, often caused by coupling through the oscillator HT rail. A dried out bypass cap on the oscillator feed rail is a prime suspect in any case of squegging.

In this set there is a 1000uF electro and a 0.1uF ceramic between the 12V rail and ground. Needless to say, replacing both of these made no difference at all.

The serrated verticals, plus the high pitched screech, convinced me that the trouble had to be somewhere around the line stage. But for a time I could think of no way to sort out just where it was. Then I had a brainwave.

There are four rails derived from the chopper power supply, but only one of these is used in the line stage. The oscillator B+ is divided down from the 160 volt main rail.

It was quite easy to disconnect the oscillator and output boards from the 160V rail and to feed them from an external DC supply. In this form the stages ran perfectly, with no trace of the noise that was so troublesome in the normal mode.

Just to make sure that the line stages were running properly, I powered up the rest of the set, using its own switched mode power supply. Immediately, the screech was back and it persisted even when the line output was turned off. So the trouble had to be in the chopper.

This was proved to be so, when I pulled the output plug off the chopper board while the power was on. The screech became much quieter, but continued on just as before.

So I had to find something that could make the chopper misbehave, even when it was not supplying a load.

As with the line board, I was looking for a low value bypass cap on one of the rails supplying the active parts of the chopper circuitry.

The first cap is a big two-part unit that filters the output of the bridge rectifier. This has some 300 volts across it and is not a thing to be treated lightly. If not properly discharged before being handled, it can deliver a powerful belt – one that could be fatal to susceptible people.

In other sets these caps are known to dry out or to go dry-jointed, either of which would lead to bad filtering. But in this case there was no such trouble.

The 12 volt rail needed to drive the chopper IC is derived from the 300 volt supply via a 22k resistor, and is stabilised by a 12V zener and a 10uF electro. I checked both these components and could find nothing wrong.

There are three large capacitors on the output rails, but I had the feeling that these had nothing to do with the trouble. So I decided to leave these until last. I was more interested in two small, low value caps around the chip, and another in a feedback loop from the chopper transformer.

C510 is a 1uF unit and C512 is a 10uF unit, both tied between pins on the chip and ground. I pulled them out and measured their capacitance. Both read 1uF. I replaced them both, even though C510 was correct and could have gone back.

That left only C521, a 4.7uF electro on the feedback winding. This also checked in at 1uF, so it too was replaced. I don't know what the attraction for 1uF was, but this power supply seemed to be full of them!

Anyway, these changes seemed to be all that was needed because when next fired up, the hardware department was silent. Only the loudspeaker revealed that the set was indeed working.

I don't know which of the three capacitors caused the screech, or it might have been all three of them. I do know that replacing them made the power supply whisper quiet and rendered the old GEC good for a few years yet.

A brief touchup to set the HT rail,

the screen controls and the AGC level, and it was showing a picture as good as any I've seen on a set of that age.

Except for one tiny thing. The serrated vertical edges in the picture were still there. Their appearance was much less noticeable, because they were somewhat smaller and not so hard-edged as they had been earlier.

I suspect that the cause lies in the line oscillator stage, but I have already spent as much time on the job as I felt was justified. I'm the only one who can see the serrations, so perhaps I'm being too critical.

I was able to call my friend to come and collect his set. His delight was quite evident from his voice and I am sure that I need never hesitate to call on him for help in future.

Bottles, bottles

My second story this month concerns ye olde valve type radios and TVs, and all the little glass 'bottles' that made the things work.

It's amazing to think that there are people of thirty or so years of age who have never used valve type equipment. Many young technicians have never seen it, let alone worked on the ancient technology.

Needless to say I got my first training on valve radios and amplifiers, long before TV, but even I have trouble at times getting back into the old technology. But I digress – here's the actual story.

A few months ago I described the troubles I had with an old HMV black and white, valve powered TV set.

My troubles were as much with the owner and his insistence that he knew what was wrong with the set. In the end, I fitted a new picture tube and a couple of resistors. Remember?

Well, three months later he was back on the phone. "Me picture's gorn. It's another resistor, just like the last time!"

I wasn't prepared to work on the set in his home, with him leaning over my shoulder and telling me which resistor he reckoned it was. I have enough trouble as it is in coping with old valve technology, without his single-minded monologue going on in the background.

So it was that the set was on the bench a day or two later, with the back off and all the little bottles glowing away like mad.

It was just as the owner had said. There was no picture, but the sound seemed to be quite OK.

I tested the various pins on the picture tube base and read voltages that seemed to agree with those shown in the service manual. I swapped the 6DX8 video output valve, in a forlorn hope that that was the trouble. But it wasn't.

With a colour TV, a frequent cause of No Picture is failure of the EHT supply. It's easy to test for EHT in a colour set – just brush the back of the hand across the screen. If the skin tingles, then the supply is all present and correct. Unfortunately, this test doesn't work with B&W sets and something more spectacular is called for.

I removed the metal cage from the line output stage and with a well insulated screwdriver, began to draw sparks off first the 6CM5 line output valve, then the 6AL3 damper diode, and finally the 1S2 high voltage rectifier. The first two valves gave a nice little 1/4" spark, while the latter one delivered a beaut inch-long blue flame. Quite obviously, there was nothing wrong with the line output stage.

These tests convinced me that the EHT was OK, so I went on to look for the fault elsewhere. However, I could find absolutely nothing wrong. The scope showed good, strong video at the picture tube cathode and I already knew that the voltages on the tube base were right. So there seemed to be simply no reason why the set wouldn't work.

The job lasted for most of the afternoon and into the early evening – and still I had no answer. In disgust, I turned off the workshop lights and prepared to go up for tea. Fortunately, I had forgotten to turn off the old HMV, and in the darkness I found the explanation that I had been seeking for hours. On the screen I could see a very faint, grossly oversized picture.

Years ago we used to test for a weak EHT rectifier by turning the brightness up and down. If the valve was weak, the picture would 'bloom', growing bigger and bigger as the brightness went down.

On the HMV I was now seeing the end result of this process. The 1S2 EHT rectifier valve had dropped its bundle, and a test with a high voltage probe showed that it could only produce about 2kV instead of the normal 15kV. A new valve was fitted and brought back a top class monochrome picture.

The owner's response was unusual but predictable. He wanted to know which resistor had failed this time. When I told him it was a valve, he said "It couldn't be!". He'd put a new valve in five years ago, but that fault turned out to be a resistor. So it had to be the same again. How do YOU cope with tunnel imagination in your clients?

Another bottle job came in a few days after the one detailed above. It was much easier to do, but quite interesting for all that.

It was a post-war Philips mantel radio, Model 113B. The converter valve was a pre-war European type heptode, while the rest of the valve line up were later, wartime GT types. In particular, the HT rectifier was a 5Y3-GT and the audio output was a 6V6-GT.

The complaint was that the set distorted badly after it had been running for an hour or two.

When I heard the distortion, I had a flood of old memories. I was prepared to bet that it was a leaky coupling capacitor on the grid of the 6V6. I've heard this so often in sets using old waxed paper caps in high voltage circuits. It was also common in early television sets, so it wasn't a fault unique to old radios. The job looked like money for jam, so out came the old cap, and in went a new one.

But it didn't cure the fault. Even so, I was still convinced that the fault had to do with the grid circuit of the audio output valve.

Unfortunately, I had no circuit diagram for this particular model. I had drawings for earlier sets, and for the immediately following model, but they were all different in many ways to the one I was working on. So apart from general guidance, I was very much on my own.

It was then that I realised that the set was sporting a different valve in the HT rectifier socket. It should have been a 5Y3-GT, but it was really a 5AR4-GT. At first, I couldn't imagine how this might affect the audio stage, and even now I'm not certain that it did. But replacing it with a 5Y3 lessened the distortion, and increased the warming up time before the distortion started.

I pulled out my old valve manuals and compared the two tubes. The 5Y3 was a filament type rectifier, with the HT supply taken from the filament itself. The 5AR4, on the other hand, was a heater-cathode type tube but with the heater and cathode tied together.

The tubes worked with similar input voltages, but the 5AR4 had a significantly higher output voltage, because of its much lower plate resistance. As a replacement for a 5Y3, it was hardly more appropriate than a couple of silicon diodes.

So far as I can recall my valve theory, the higher HT rail put a higher bias on the grid of the audio valve. This might have been of no consequence, if the grid resistor had been of stable value.

Unfortunately, as the set warmed up, the grid resistor went higher in resistance, while the extra HT voltage forced the tube to continue conducting when it should have been cut off. The result was hideous distortion.

The colour code had been burnt off the old resistor, so I had to guess what the value might have been. Fortunately, I have a decade resistance box and it didn't take long to find that a 100,000 ohm 1 watt resistor was the ideal replacement.

After that, all the voltages settled around normal, and no amount of heating could bring on the distortion.

It's interesting to speculate on whether any of this might have been necessary if the owner had replaced the original 5Y3 with a similar type, instead of the newer and much more efficient 5AR4.

Well, that's enough for this month. See you again next time!

Fault of the Month

HMV C221, 231

SYMPTOM: Erratic start up, power supply hiccupping. Sometimes set will not start at all, at other times starts only after switch has been pressed many times in quick succession. Only rarely will the set start first time.

CURE: TR102 (BR203) regulating SCR faulty. On bench-test, the chopper should start at 180V input but with this fault, will not start until input reaches 220V. The BR203 tests OK but appears to have lost sensitivity.

This information is supplied by courtesy of the Tasmanian branch of The Electronic Technicians' Institute of Australia. Contributions should be sent to J.Lawler, 16 Adina Street, Geilston Bay, Tasmania 7015.

BEAT THE NEW LAWS
Legislation is being introduced to limit CFC products in all states during 1989

Non-CFC
Service Aids

MADE IN AUSTRALIA FOR AUSTRALIAN CONDITIONS

Electronic Freezing Spray
Non-CFC, non-corrosive, safe method of cooling electronic components to detect dry joints and other thermal faults.

Electronic Cleaning Solvent No. 1
Fast drying non-CFC solvent blend for cleaning electronic components and circuit boards.

Printed Circuit Board Lacquer
Specially formulated lacquer designed specifically for protecting circuit boards and components from environmental attack. Can be soldered through for component replacement and acts as a solder flux.

Proteck
General purpose maintenance, dewatering and penetrating fluid for protecting, lubricating and rust prevention.

Heat Sink Compound
An efficient, not-toxic paste with excellent thermal conductivity over a wide temperature range.

Available from:
NSW
- Digitel Pty Ltd YAGOONA Ph 796 2888
- WES Components Pty Ltd ASHFIELD Ph 797 9866
- Carramar Radio CARRAMAR Ph 726 3628
- Macelec Pty Ltd WOLLONGONG Ph 042 29 1455
- D J Coulter Wholesale Pty Ltd MAYFIELD Ph 049 67 1455
- Novocastrian Electronic Supplier BROADMEADOW Ph 049 62 1358
- Vimcon Pty Ltd WOLLONGONG Ph 042 28 4400
- Sheridan Electronics Pty Ltd REDFERN Ph 699 5922
- NEC Home Electronics Aust Pty Ltd REVESBY Ph 774 5122
- Altronic Imports CROWS NEST Ph 436 0422
- Jaycar SYDNEY Ph 267 1614
- Jaycar GORE HILL Ph 439 4799
- Jaycar HURSTVILLE Ph 570 7000
- Jaycar CONCORD Ph 747 2022
- Jaycar PARRAMATTA Ph 683 3377
- Royston Electronics SILVERWATER Ph 647 1533

Queensland
- AES Electronics FORTITUDE VALLEY Ph 07 52 8233
- Selectro Parts Pty Ltd YERONGA Ph 07 848 8197
- Jaycar BURANDA Ph 07 393 0717

South Australia
- Protronics Pty Ltd ADELAIDE Ph 08 212 3111

Victoria
- Electronic Engineering Supplies BRAESIDE Ph 03 587 3888
- Royston Electronics NOTTINGHILL Ph 03 343 5122
- Jaycar MELBOURNE Ph 03 663 2030
- Jaycar SPRINGVALE Ph 03 547 1022

W.A.
- Everett International Pty Ltd WEST LEEDERVILLE Ph 09 381 5500
- Altronic Imports Pty Ltd PERTH Ph 09 328 2199

rf
RICHARD FOOT PTY LTD
Telephone (02) 450 2133
Fax (02) 450 2569
Telex AA24777

News Highlights

Exide hotline

The industrial division of Australia's own battery manufacturer, Pacific Dunlop Batteries, has set up the Exide Hotline to answer queries and give advice to industrial battery users.

The number, 008 02 3785, is toll-free to callers throughout Australia.

Front-man for the Exide Hotline is Ewan Cheyne-MacPherson, who has been set up with access to Pacific Dunlop's full information resources.

These include data on batteries, chargers, inverters, emergency lighting and related technologies for use in diesel starting, DC traction motors, switch closing and tripping, standby power, UPS, emergency lighting, alarm and security systems, solar power, remote repeater stations, portable powered equipment and telecommunications.

AFTRS on air

A radio training studio equipped by Sydney manufacturer RME (Radio Manufacturing Engineers) went to air for the first time in the history of the Australian Film, Television and Radio School during the opening of their new building. The impressive new building and facilities at North Ryde were opened recently by the Prime Minister.

The new radio teaching facilities have been equipped with a model 400 RME Phoenix series console and desk. Two additional RME consoles and control equipment were moved from the school's former premises in North Ryde.

All RME equipment provided has been customised to the special requirements of the school. The resultant configuration and layout provide a unique teaching environment, enabling students to become proficient in all aspects of radio broadcasting.

The purpose-built studios provide maximum student participation in a professional environment. The official opening was broadcast live on 2SER-FM by the school staff and ex students with technical assistance from RME, Telecom and 2SER.

Programmers newsletter

MicroWay is publishing a newsletter specifically for programmers. Called MicroWay News, the newsletter provides information on the latest programming software and programming techniques.

Best known for their wide range of programmers tools, MicroWay is utilising its resources and its close relationship with a large number of developers both overseas and throughout Australia, to produce a Newsletter which specifically appeals to professional programmers.

The newsletter is comprised of articles on new products with detailed product descriptions, information regarding the latest versions of products and changes between versions, other news of general interest to programmers, as well as reprints of various magazine articles.

MicroWay News is available for free to professional programmers by contacting MicroWay at 292 Chesterville Road, Moorabbin 3189, phone (03) 555 4544 or (03) 555 4932.

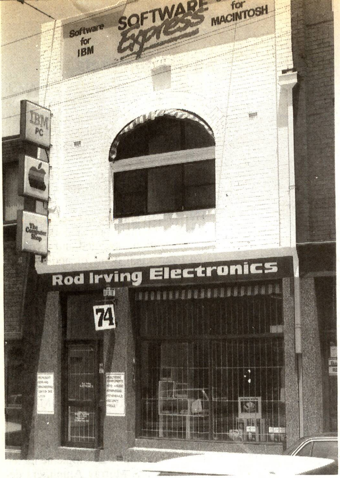
AWA fibre optics for Aust. army

AWA has successfully developed a battlefield fibre optic communications system (FOCS) for the Australian Army.

The new system is at the leading edge of military fibre optic technology and is certainly among the most advanced of its kind in the world. It is currently undergoing final testing prior to the manufacture of prototypes.

AWA's FOCS has been designed to handle communications tasks within the Army's Parakeet system. Parakeet consists of a network of mobile communications centres – known as 'nodes' – which link the frontline soldiers to Australia's fixed communications network, codenamed Discon.

One soldier can handle one kilometre of fibre-optic cable, as opposed to just 250 metres of the heavier coaxial cable. The fibre-optic cable used in FOCS can carry 120 voice channels – or nearly 200 if the auxiliary channel is used – which compares to just 24 voice channels for equivalent coaxial cable. FOCS cable can carry facsimile or other digital data and is so rugged that trucks can be driven over it, or even over the connectors between cable lengths, without causing damage. It can also be laid from drums mounted in trucks or helicopters for even greater mobility and speed.



Rod Irving's new Sydney store opens

Melbourne-based Rod Irving Electronics has opened its first store in Sydney, at 74 Parramatta Road, Stanmore. The phone number is (02) 519 3134.

Townsville Amateur Radio Club

About 50 members and families attended the recent Annual General Meeting of the Townsville Amateur Radio Club. The meeting was held at the James Cook University Club, and was preceeded by a dinner. An indication of the stability of the TARC was the attendance at the meeting of 6 past presidents.

A total of 31 positions were filled for the coming year's activities. The president, Rob Male, can be found on VK4MRE.

Nuclear magnetic resonance

An ingenious new way to use nuclear magnetic resonance (NMR) to study solid materials has been developed by scientists at the Lawrence Berkeley Laboratory and the University of California, Berkeley.

The new method, known as Double Rotation (DOR) NMR, involves spinning a sample around two axes at the same time, like a top within a top.

The DOR technique will greatly extend the range of NMR, one of the most powerful tools of modern science. It can improve up to 100 times the accuracy with which scientists can distinguish between different specific locations and positions of atoms in a solid.

The technique was developed by a team led by Alexander Pines, professor in UC Berkeley's Department of Chemistry and senior scientist at the Lawrence Berkeley Laboratory's Materials and Chemical Sciences Division.

Voice and data network

Perth-based Challenge Bank Limited is installing an Australia-wide, high speed digital backbone integrated voice and data communications network based on Datacraft Australia's MegaCraft 2 Megabit system.

The network, designed by communications consulting engineers Gibson Quai and Associates of Perth, consists of MegaCraft 3600 series intelligent multiplexers linked by Telecom Australia Megalink and 48K DDS services.

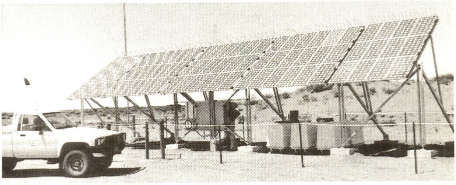
It will provide major voice and data links between the bank's head office in Perth and two other key sites in Melbourne with connections for smaller sites.

The implementation of the network will result in substantial savings in Telecom transmission charges, by rationalisation and integration of voice tie lines and low speed data lines onto the high speed private backbone digital network.

Solar powered anti-corrosion system

Gas wells and pipelines in some of Australia's major gas fields are being protected by what is claimed to be the biggest solar powered cathodic protection system ever installed in this country.

Cathodic protection uses electricity to prevent corrosion on pipes and vessels which are buried or in contact with the ground. BP Solar Australia recently supplied systems to protect the pipelines and wells of the Bookabourdie fields in the Cooper basin of South Australia. The system protects seven gas wells and the pipeline system on the Bookabourdie field as well as powering a telemetry system that transmits vital information to the central control room at Moomba 120 kms away.



The wells go down almost 7000 feet and being constructed of bare pipe are prone to external corrosion. Cathodic protection is the most effective way of preventing external corrosion of the wells and the pipeline on the 120 km journey to Moomba.

News Highlights

PCB manufacturer changes hands

The extensive printed circuit board manufacturing operations of the Adelaide-based Teknis Group have been purchased as a going concern by major Australian electronics company, Delen Corporation Pty Ltd.

The acquisition extends the privately-owned Delen corporation's position as Australia's largest printed circuit board manufacturer. Sydney based Delen has purchased the business of Tekpro – the main manufacturing division of publicly-listed Teknis Limited which was placed in receivership in May.

Adelaide chartered accountants, Messrs John Heard and Stephen Young of Allert Heard & Co, were appointed joint receivers and managers of Teknis Limited and Teknis Consolidated Pty Ltd. The companies owed more than $8 million at the time of the appointment.

Mr Young said the sale to Delen Corporation, for an undisclosed amount, followed extensive national and international interest in Tekpro, which had in recent years developed its Hendon (South Australia) printed circuit board (PCB) facility to worldwide competitve standards.

Sound contracts

Local manufacturer Murray Amplifiers has completed three major contracts for the supply of audio equipment to the new Federal Parliament House in Canberra, the Sydney Opera House and Power House Museum in Sydney.

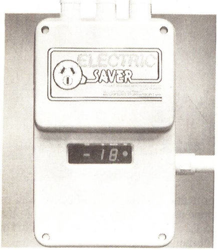
The three contracts which were for 2844 amplifiers were worth in excess of $2.5 million.

Murray Amplifiers, acting as a subcontractor to the Australian Broadcasting Corporation, designed and manufactured over 5,000 items of audio equipment which were installed in the Federal Parliament House. Equipment supplied included more than 900 special purpose microphone amplifiers, over 1200 distribution amplifiers and 176 power amplifiers.

The company also designed and supplied 76 power amplifiers and 50 sound distribution amplifiers to the Sydney Opera House. The model MA538L power amplifiers delivered are each capable of supplying 300 watts into 4 ohms and 150 watts via a 100 volt line output. This contract supplements 80 amplifiers which Murray Amplifiers delivered in 1985.

The sound distribution amplifiers were specially designed for the Sydney Opera House and incorporate peak program meter, remote gain control and transformer isolating options.

The Power House Museum at Ultimo in Sydney has taken delivery of over 100 Murray Amplifier monitor amplifiers. They are used to provide audio to many of the exhibits throughout the building. The power amplifiers are used for high level sound required by the N. 1 Steam Locomotive, while the interface units are used with infra-red detectors to control sound level depending on the presence of people at the various exhibits.



Energy saver

A new energy saving device recently launched in Sydney will save Australian business millions of dollars in power bills each year, according to its manufacturer, Megapine Pty Ltd.

The Electric Saver represents a major breakthrough in thermostat technology and is claimed to slash electricity costs for commercial power users by up to 50%. The self programming unit achieves these savings by maintaining extremely accurate temperatures on the plant or equipment it is controlling, and hence leads to greater efficiency and more effective energy use.

It can be employed on virtually any commercial or industrial plant to achieve dramatic power savings in refrigeration, air conditioning or hot water environments.

Megapine has appointed a network of distributors to market the product throughout Australia and is currently investigating international marketing opportunities.

Queensland electronics show

Queenslanders have an opportunity to see the latest advances in consumer electronics at the FM104 Queensland Electronics Show to be staged in Brisbane from 23rd-25th June. The exhib ition is planned to be the most comprehensive show of its kind on the east coast of Australia and has attracted support from the biggest names in the Electronics Industry.

The show will be held at the Exhibition Building, RNA Showgrounds Brisbane, and will feature a vast area of static displays as well as live demonstrations in specially constructed rooms positioned throughout the show.

On display will be the latest in hi-fi equipment, including top end hi-fi, car stereo, television and video, personal computers and peripherals, electronic musical instruments, home electronic appliances and much more. Highlights of the show will be demonstrations of CD-video, digital audio tape (DAT) and the new breed of television monitors.

For more information contact the organsier, Mr Robert Woodland at Queensland Exhibition Services (07) 273 4066.

Design award

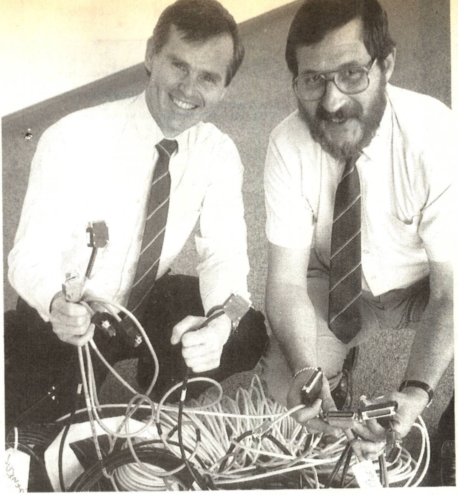
The Hon. Neil Pickard, NSW Minister for Mineral Resources and Energy recently presented Liverpool company, Advanced Power Products, with an Australian Design Award for their 'Intelligen' product.

In presenting the award the minister said, "To recognise through the grant of a prized Australian Design Award the innovation, the skills and industry of a young Australian company, Advanced Power Products, in an internationally competitive and technical field."

Intelligen is a sophisticated yet user friendly microcomputer which automatically controls, monitors and protects diesel engines linked to electrical generators, usually acting as an emergency backup electricity supply.

One of the more sophisticated applications of the system was recently installed at the Greenslopes Repatriation Hospital in Brisbane. This contract called for a 50kVA generator powered by a natural gas engine to operate as an automatic standby to mains power with auto paralleling to the mains supply on re-establishment of mains power.

The company is located at 27 Shepherd Street, Liverpool 2170, phone (02) 600 6555.



Computer connections

The giant Metal Manufacturers group has established a new division named DATACON to tailor connectors, cables and fibre optics for virtually any computer installation in Australia.

Jeremy Cubitt, divisional manager of DATACON says it was established to assist the electrical contractors who are the traditional customers of the TLE and HAYTECH divisions of Metal Manufacturers.

"Electrical contractors are moving more and more into the area of computer installation or system re-location. We have set ourselves up to give the materials and technical advice that they need to work in these areas to the fullest satisfaction of their clients" he says.

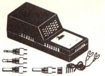
DATACON carries over 800 individual parts ranging from the smallest RS232 connector to a 32 port, fibre optic, multiplexer.

The company is located at 5/552-560 Church Street, Parramatta 2150 or phone (02) 683 1399.

News Briefs

- ***Voca Communications*** has appointed Ian Redfern as manager, branch operations, reporting to Voca's general manager, Paul McNicholl.
- The Australian Optical Disc conference, being organised by ***RMIT***, will be held at the Southern Cross Hotel, Melbourne, on the 9th and 10th of June.
- ***Precision Monolithics*** has announced the acquisition of SSM Audio Products (SSM) – formerly known as Solid State Micro Technology for Music.
- Professional audio and broadcast equipment distributor ***Amber Technology*** has moved its Perth headquarters to new premises in Subiaco. The new address is Suite 2A, 272 Hay Street, and the phone number is (09) 382 2135.
- Bill Woolridge has been appointed ACT branch manager for ***NEC Information Systems***.
- ***The George Brown Group*** has appointed Bob Crabbe as its new managing director. Brian Baldwin has also been appointed to the board.
- A new sales office has been opened in Canberra by ***Data Bridge***, under the direction of Philip Holleley.

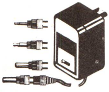
ROD IRVING ELECTRONICS



POWER ADAPTORS 1 AMP POWER PACK

- 240V AC to 6/7.5/9/12V DC
- Ideal for workshop
- DC connections via unique multi plug adaptor system
- Sizes: 2.5, 3.5mm phone and 2.1, 2.5mm DC plug
- Cord 1.6 metre long

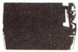
Cat. M19010 ...... **$36.95**



PLUG IN POWER PACK

- 240V AC to 6/9/12V DC - 300mA
- 1.6 metre cord with unique plug adaptors
- Plugs: 2.5 & 3.5 phone plugs, 2.1 & 2.5mm DC plug.

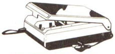
Cat. M19001 ...... **$11.95**



RECHARGEABLE 12V GELL BATTERIES

Leakproof and in 3 convenient sizes, these long service life batteries are ideal for burgular systems, emergency lighting or as a computer backup power supply. Ideal for many power needs.

Cat.S15029 12V 1.2 AH **$13.95**
Cat.S15031 12V 2.6 AH **$39.50**
Cat.S15033 12V 4.5 AH **$49.95**



SUPER DELUXE BATTERY CHARGER

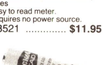
- Charges from 1 to 10 D, C, AA, AAA, N, and up to 3 x 9V batteries at the same time.
- Dual colour LED in first three compartments to designate 1·5V or 9V.
- 240V AC/50Hz.
- Approval No. N10637

Cat.M23525 .... **$59.95**

POCKET SIZE BATTERY TESTER

- Tests all 9V to 1·5V batteries including button cells.
- Arms extend to various battery sizes
- Easy to read meter.
- Requires no power source.

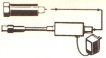
M23521 .... **$11.95**



NICADS!

Save a fortune on expensive throw away batteries with these quality Nicads and Rechargers!

Size	Desc.	1-9	10+	100+
AA	450 mA.H.	**$2.95**	**$2.75**	**$2.50**
C	1.2 A.H.	**$9.95**	**$9.50**	**$8.95**
D	1.2 A.H.	**$9.95**	**$9.50**	**$8.95**

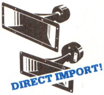


10dB IN-LINE COAXIAL AMPLIFIER

Reduces loss from splitters and long cable runs. Suitable for use with antennas, coaxial feed lines and VCR's. A/C adaptor included.

SPECIFICATIONS:
Frequency Range: 5-900MHz
Gain: 10dB
Power Requirements: 12V A/C Adaptor (included)
Input Impedance: 75 ohm
Output Impedance: 75 ohm

L15043 .... **$39.95**


DIRECT IMPORT!

MIDRANGE HORNS

Use these quality, all metal, Piezo tweeters for great top end sound in your band speakers, disco sound system, etc. Rated at 30W RMS, in a system they will handle over 100 watts RMS.

Two sizes to choose from:
Size: 4"x 10½"
Impedance: 8 ohms
Rating: 30 watts RMS
Response: 1.5kHz - 14 kHz
Dimensions: 102 x 267 x 177mm

C92082 .... **$39.95**

Size: 3"x 7"
Impedance: 8 ohms
Rating: 30 watts RMS
Response: 2kHz - 15 kHz
Dimensions: 76 x 177 x 145mm

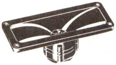
C92084 .... **$24.95**

Dealers, OEM's, etc., phone (03) 543 2166 for wholesale prices

P.A. SPEAKERS

Low dual cone, wide range. 200mm (8in.). Ideal for public address, background music, etc. Tremendous Value at these prices! Cat.C12000

1-9	10+
$5.95	**$5.50**



SUPER HORN TWEETER

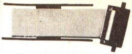
- Requires no crossover and handles up to 100W!
- Sensitivity: 100dB/0.5m
- Freq. Response: 3kHz-30kHz
- Impedance: 8 OHMS
- Size 96mm diameter

Cat. C12102 .... **Normally $12.95**
SPECIAL, ONLY $9.95

OMNI-DIRECTIONAL WIRELESS MICROPHONE

Tuneable: 92 - 104MHz
Freq. Response: 50 - 15kHz
Range: Over 300 feet in open field.
Modulation: FM
Power Source: 9V Battery
Type: Electret Condenser.
Dimensions: 185 x 27 x 38mm
Weight: 160 grams

Cat. A10450 .... **$19.95**



GREY FLAT RIBBON CABLE

Cat No.	Description	$/Mtr
W12614	14 Way	**$1.90**
W12616	16 Way	**$2.20**
W12620	20 Way	**$2.50**
W12624	24 Way	**$2.90**
W12625	25 Way	**$3.20**
W12626	26 Way	**$3.60**
W12634	34 Way	**$3.90**
W12636	36 Way	**$3.90**
W12640	40 Way	**$4.90**
W12650	50 Way	**$5.90**
W12660	60 Way	**$6.90**

COMPUTER CABLE

CIC6 6 conductor computer interface cable. Colour coded with braided shield.
(to IE422 specifications).
Copper conductor 6 x 7/0.16mm.

1-9 metres	10+ metres
$1.90/m	**$1.70/m**

CIC9.100 9 conductor computer interface cable. Colour coded with mylar shielding. 9 x 7/0.16mm.

1-9 metres	10+ metres
$2.50/m	**$1.95/m**

CIC12 12 conductor computer interface cable. Colour coded with mylar shielding. 12 x 7/0.16mm.

1-9 metres	10+ metres
$2.70/m	**$2.50/m**

CIC16 16 conductor computer interface cable. Colour coded with mylar shielding. 16 x 7/0.16mm.

1-9 metres	10+ metres
$3.90/m	**$3.40/m**

CIC25 25 conductor computer interface cable. Colour coded with mylar shielding. 25 x 7/0.16mm.

1-9 metres	10+ metres
$4.90/m	**$4.40/m**

HOOK UP WIRE

Cat. No. Description
W11251 13/.12 TND BLK
W11252 13/.12 TLD BROWN
W11253 13/.12 TLD ORANGE
W11254 13/.12 TLD YELLOW
W11255 13/.12 TLD GREEN
W11256 13/.12 TLD BLUE
W11257 13/.12 TLD WHITE

PRICES PER 100 METRE ROLL

1-9	10+
$5.95	**$5.00**

W11260 14/.20 RED
W11261 14/.20 BLACK
W11265 14/.20 BLUE
W11268 14/.20 WHITE

PRICES PER 100 METRE ROLL

1-9	10+
$12.00	**$10.00**

W11270 24/.20 RED
W11272 24/.20 BLACK
W11274 24/.20 GREEN

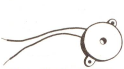
PRICES PER 100 METRE ROLL

1-9	10+
$14.00	**$12.00**

W11280 32/.2 BROWN
W11282 32/.2 BLUE

PRICES PER 100 METRE ROLL

1-9	10+
$20.00	**$18.00**



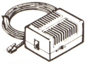
42mm PIEZO BUZZER

S15073 .... **$7.95**

4A REGULATED POWER PACK

- 240V AC input to 13·8V DC regulated 1A outlet
- Ideal for CB, ham radio, and other high power applications
- Fully overload and short circuit protected
- Will handle up to 6A surge current
- Ripple less than 10mV peak-peak
- Large heatsink and vent system for cooling
- Outputs: screw terminals or 4mm banana sockets
- Illuminated on/off switch
- Fuse protected
- Approved by the Department of Energy

M19032 .... **$139**



TELEPHONE EXTENSION BELL

- 10 metre length extension cord.
- Features US type plug
- Use with US/Australian adaptor

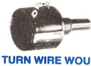
Y16043 .... **$25.95**

MAIL ORDER HOTLINE
008 335757
(TOLL FREE)
LOCAL: 543 7877

CODE KEY PAD

- Telephone type digital keypad.
- Four digit, changeable code.
- Over 5000 possible combinations
- Power consumption: 5mA standby, 50mA alarm.
- Two sector LED and 1 arm LED.
- Wrong number lockout.
- 12V DC operation.
- Relay output.
- Panic button.
- Normally open tamper switch.
- Dimensions: 145 x 100 x 37mm
- ACP3 compatible.

A13014 .... **$79.95**
SPECIAL, ONLY $69.95

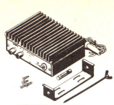


10 TURN WIRE WOUND POTENTIOMETER

Spectrol Model 534 ¼" shaft.
Equivalent (Bourns 3540S, Beckman 7256)
Dials to suit 16-1-11, 18-1-11, 21-1-11.

R14050	50R	R14100	5K
R14055	100R	R14110	10K
R14060	200R	R14120	20K
R14070	500R	R14130	50K
R14080	1K	R14140	100K
R14090	2K		

1-9	10+
$9.95	**$9.50**



STEP DOWN CONVERTER DC-DC

Built around a heavy duty heatsink this unit features the latest transistor switching technology to convert 24V DC to 13·8V DC. Finished in matt black with a unique mounting bracket makes it the best in its class.

SPECIFICATIONS:
Input Voltage: 24V DC
Output Voltage: 13·8V DC
Primary Current: 4·2A (24V input 4A output)
Output Current: 4A continuous rated (5·5A max.)
Size: 125(W) x 50(H) x 90(D)mm
Weight: 450 grams

A16155 .... **$99.95**

10A STEP DOWN CONVERTER DC-DC

Built around a heavy duty heatsink this unit features the latest transistor switching technology to convert 24V DC to 13·8V DC. Finished in matt black.

SPECIFICATIONS:
Input Voltage: 24V DC
Output Voltage: 13·8V DC
Primary Current: 11A (24V input, 10A output)
Output Current: 8A continuous rated (12A max.)
Size: 125(W) x 50(H) x 175(D)mm
Weight: 900 grams

A16160 .... **$119.95**

KEY SWITCHES

Cat. S12500 .... Normally 1-9 $7.95 10+

1-9	10+	25+
$4.95ea	**$4.25ea**	**$3.95ea**

RCA GOLD PLATED PLUGS AND SOCKETS

For those who need the ultimate in connection. Essential for compact disc players to get that fantastic sound quality.

Plug (P10151) **$2.95**
Socket (P10150) **$2.25**

RCA GOLD PLATED CHASIS SOCKET

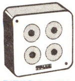
For the ultimate connection!
Cat. P10229 .... Normally $1.75

1-9	10+	100+
$1.00	**$0.90**	**$0.85**

CAR ANTENNA BOOSTER

- In-line instalation
- 12V boosts 100%

Cat.A12073 .... **$7.95**



PIEZO SIREN

- 4 piezo units in a high impact plastic cabinet
- Input 12V DC - 200mA
- Output 115dB at 1m, dual tone
- Compact size 105 x 85 x 45mm
- Smart design suits interior use

Cat. S15071 .... **$24.95**

ROD IRVING ELECTRONICS, YOUR COMPLETE DISCOUNT ELECTRONICS STORE!

PANEL METERS

We have too many of the following panel meters, so we're selling them to you at bargain prices. Don't miss out!

Cat.No.	Description	Price
Q10500	MU45 0-1mA	10.50
Q10502	MU45 0-50uA	12.50
Q10535	MU45 VU	10.95
Q10533	MU52E 0-5A	14.50

CAR BATTERY ISOLATOR

Designed for car burglar alarm back-up batteries, this isloator allows the back-up battery to be charged from the car battery while preventing the back-up battery from draining back to the car battery.

A12095 .... **$3.20**

TRIGGER TRANSFORMERS

M10104 .... **$1.45**

XENON/STROBE TUBES

As used in projects or as replacements

S14050 .... **$2.95**

BRAND NEW FANS

Quality, new fans for use in power amps, computers, hotspot cooling etc. Anywhere you need plenty of air!

240V 4⅝"	Cat. T12461	**$12.95**
115V 4⅝"	Cat. T12463	**$12.95**
240V 3½"	Cat. T12465	**$12.95**
115V 3½"	Cat. T12467	**$12.95**

10+ fans (mixed) only $11.95 each

FAN GUARDS TO SUIT

4⅝"	Cat.	T12471	**$3.95**
3½"	Cat.	T12475	**$3.95**

BRAND NEW BALL BEARING FANS

Quality, new ball bearing fans suitable for power amps, computers, hotspot cooling etc. Anywhere you need plenty of air!

240V 4⅝" **$16.95**

10+ fans (mixed) only $15.95 each

SPECTROL 64Y MULTI TURN TRIMPOTS

Cat.No.	Description	1-9	10+
R14700	10R	**$3.50**	**$3.20**
R14710	20R	**$3.50**	**$3.20**
R14720	50R	**$3.50**	**$3.20**
R14730	100R	**$3.50**	**$3.20**
R14740	200R	**$3.50**	**$3.20**
R14750	500R	**$3.50**	**$3.20**
R14760	1K	**$3.50**	**$3.20**
R14770	2K	**$3.50**	**$3.20**
R14780	5K	**$3.50**	**$3.20**
R14790	10K	**$3.50**	**$3.20**
R14800	20K	**$3.50**	**$3.20**
R14810	50K	**$3.50**	**$3.20**
R14820	100K	**$3.50**	**$3.20**
R14830	200K	**$3.50**	**$3.20**
R14840	500K	**$3.50**	**$3.20**
R14850	1M	**$3.50**	**$3.20**

ECONOMY TRANSFORMERS

	1-9	10+
2155 240V 6-15V 1A Cat. M12155	**$9.95**	**$8.95**
2156 240V 6-15V 2A Cat. M12156	**$14.95**	**$13.95**
2840 240V 9V CT Cat. M12840	**$5.95**	**$4.95**
2851 240V 12-6V CT 150mA Cat. M12851	**$5.95**	**$5.50**
2860 240V 15V CT 250mA Cat. M12860	**$5.95**	**$4.95**
6672 240V 15-30V 1A tapped Cat. M16672	**$14.95**	**$13.95**

CHROME LED BEZELS

9mm hole, available 3 colours

Cat.No.	Description	Price
S14030	Red	**$1.20**
S14032	Green	**$1.45**
S14034	Yellow	**$1.45**

DB25 CONNECTOR SPECIALS!

TYPE	1-9	10+	100+
9P	$0.70	$0.60	$0.50
9S	$0.70	$0.60	$0.50
9C	$0.60	$0.50	$0.40
15P	$0.70	$0.65	$0.60
15S	$0.70	$0.65	$0.60
15C	$0.70	$0.60	$0.50
25P	$0.70	$0.60	$0.50
25S	$0.75	$0.65	$0.60
25C	$0.70	$0.60	$0.50

DB 25 CRIMP SPECIALS!

Type	1-9	10+	100+
Female	**$2.95**	**$2.50**	**$1.95**
Male	**$2.95**	**$2.50**	**$1.95**

RELAYS

1-9	10+	100+
S.P.D.T. 3A connectors		S14060
$1.50	**$1.30**	**$1.10**
D.P.D.T. 3A connectors...		S14061
$1.95	**$1.75**	**$1.30**
S.P.D.T. 12V Coil 10A 240V		S14114
$7.95	**$7.50**	**$6.95**

LOW PROFILE IC SOCKETS

Save a small fortune on these "Direct Import" low profile IC sockets! PCB mounting solder tail. All tin plated phosphor bronze or berryllium and dual wipe for reliability.

Cat.No.	Description	1-9	10+
P10550	8 pin	**$0.20**	**$0.15**
P10560	14 pin	**$0.25**	**$0.20**
P10565	16 pin	**$0.35**	**$0.20**
P10567	18 pin	**$0.40**	**$0.30**
P10568	20 pin	**$0.40**	**$0.30**
P10569	22 pin	**$0.40**	**$0.30**
P10570	24 pin	**$0.40**	**$0.30**
P10572	28 pin	**$0.50**	**$0.40**
P10575	40 pin	**$0.50**	**$0.40**

GOLD INSERT LOW PROFILE IC SOCKETS

- Gold machined pins
- Extremely high quality
- Anti-wicking.
- Ideal for professional use or where field service of components is required.

Cat.No.	Description	1-9	10+
P10620	8 pin	**$1.20**	**$1.10**
P10624	14 pin	**$1.60**	**$1.50**
P10626	16 pin	**$1.90**	**$1.80**
P10628	18 pin	**$2.00**	**$1.80**
P10630	20 pin	**$2.20**	**$2.00**
P10632	22 pin	**$2.40**	**$2.20**
P10634	24 pin	**$2.60**	**$2.40**
P10640	28 pin	**$2.90**	**$2.60**
P10644	40 pin	**$3.00**	**$2.70**

WIRE WRAP IC SOCKETS

These quality 3 level wire wrap sockets are tin-plated phosphor bronze.

Cat.No.	Description	1-9	10+
P10579	8 pin	**$1.50**	**$1.40**
P10580	14 pin	**$1.85**	**$1.70**
P10585	16 pin	**$1.95**	**$1.80**
P10587	18 pin	**$1.95**	**$1.80**
P10590	20 pin	**$2.95**	**$2.70**
P10592	22 pin	**$2.95**	**$2.70**
P10594	24 pin	**$3.95**	**$3.50**
P10596	28 pin	**$3.95**	**$3.50**
P10598	40 pin	**$4.95**	**$4.50**

IEC PLUG

3 pin, female line plug. 250V, 6A

P10251 .... **$2.95**

RAM CHIPS!

Description	1-9	10 plus
4164-12	**$6.95**	**$6.50**
41256-12	**$24.95**	**$23.95**

8087 CHIPS

GENUINE INTEL CHIPS!

8087-3 (4.77MHz)	**$245**
8087-2 (8MHz)	**$350**
8087-1 (10MHz)	**$475**
80287-6 (6MHz)	**$375**
80287-8 (8MHz)	**$555**
80287-10 (10MHz)	**$690**
80387-16 (16MHz)	**$995**
80387-20 (20MHz)	**$1460**
80387-25 (25MHz)	**$1860**

QUALITY 3mm LEDS

Cat. No.	Col.	1-9	10+	100+
Z10140	Red	**$0.15**	**$0.12**	**$0.10**
Z10141	Grn	**$0.20**	**$0.15**	**$0.12**
Z10143	Ylw	**$0.20**	**$0.15**	**$0.12**
Z10145	Ora	**$0.20**	**$0.15**	**$0.12**

QUALITY 5mm LEDS

Cat. No.	Col.	1-9	10+	100+
Z10150	Red	**$0.08**	**$0.07**	**$0.06**
Z10151	Grn	**$0.15**	**$0.12**	**$0.10**
Z10152	Ora	**$0.15**	**$0.12**	**$0.10**

MINI JUMPERS

- Contact terminal: Phospor bronze
- Material: P.B.T. 94V-0
- Gold plated

Qty.	Cat.No.	Price
10	P12053	**$ 2.95**
25	P12055	**$ 4.95**
100	P12057	**$21.95**

CANNON TYPE CONNECTORS AT SPECIAL PRICES!!

Cat. No. Description	Price
P10960 3 pin line male. Was $3.90	**NOW $2.90**
P10962 3 pin chasis male Was $3.00	**NOW $2.40**
P10964 3 pin line female Was $4.50	**NOW $3.25**
P10966 3 pin chasis female Was $4.95	**NOW $3.45**

HIGH INTENSITY RED LED BAR GRAPH

Dimensions:
Overall: 63mm across, 5mm high.
LEDs: 10 x 5mm x 1mm

Cat.No.	1-9	10+
Z10180	**$2.95**	**$2.75**

IC SPECIALS!

WHILE STOCKS LAST
IN QUANTITIES OF 10 ONLY

7404	$0.50ea
7406	$0.50ea
7416	$0.50ea
7445	$0.60ea
74123	$0.50ea
74LS162	$0.50ea
74LS393	$0.90ea
LM339	$0.50ea
LM3086	$0.50ea
8256	$4.00ea

1 MEG DRAM

MCM 511000P-10
DUAL IN-LINE
$59.95

rie

ROD IRVING ELECTRONICS

All sales tax exempt orders and wholesale inquiries to:
RITRONICS WHOLESALE,
56 Renver Road, Clayton.
Phone: (03) 543 2166 (3 lines)
Fax: (03) 543 2648

SYDNEY: 74 Parramatta Rd.
Stanmore. 2048.
Phone (02) 519 3134
Fax (02) 519 3868

MELBOURNE: 48 A'Beckett St.
Phone (03) 663 6151

NORTHCOTE: 425 High St.
Phone (03) 489 8866

CLAYTON: 56 Renver Rd.
Phone (03) 543 7877

MAIL ORDER & CORRESPONDENCE:
P.O. Box 620, CLAYTON 3168
Order Hotline: 008 33 5757
(Toll free, strictly orders only)
Inquiries: (03) 543 7877
Telex: AA 151938
Fax: (03) 543 2648

ORDER HOTLINE
008 335757
(TOLL FREE)
STRICTLY ORDERS ONLY

LOCAL ORDERS & INQUIRIES
(03) 543 7877

POSTAGE RATES:

$1 – $9.99	**$2.00**
$10 – $24.99	**$3.00**
$25 – $49.99	**$4.00**
$50 – $99.99	**$5.00**
$100 plus	**$7.50**

The above postage rates are for basic postage only. Road Freight, bulky and fragile items will be charged at different rates.

Errors and omissions excepted. Prices and specifications subject to change.

IBM*, PC*, XT*, AT*, are registered trademarks of International Business Machines. *Apple is a registered trademark. *Denotes registered tradmarks of their respective owners.

ROD IRVING ELECTRONICS

ROD IRVING ELECTRONICS

ROD IRVING ELECTRONICS, YOUR COMPLETE DISCOUNT ELECTRONICS STORE!

SURGE BUSTER!

6 PROTECTED POWER OUTLETS

Protect your valuable electronic equipment from damaging power surges. Ideal for protecting personal computers, video equipment, colour TVs, amplifiers, tuners, graphic equalisers, CD players etc.

SPECIFICATIONS:

Electrical rating: 240V AC, 50Hz, 10A

Complies with Australian Standards. Approval number N10084.

3 x Metal Oxide Varistors (MOV)

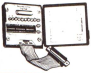
Surge/Spike Rating (each MOV): 4,500 amps (8x 20us)

Energy Absorb. Factor each MOV: 75 joules (10 x 1000us)

Maximum Clamping Voltage: each MOV: 710 volts at 50 amps

Response time: Less than 25 Nanoseconds.

X10086 .... **$69.95**



RS232 BREAK OUT BOX

A simple way of monitoring RS232 interface lead activity. Interface powered, pocket size for circuit testing, monitoring and patching. 10 signal powered LED's and 2 spares. 24 switches enables you to break out circuits or reconfigure and patch any or all the 24 active positions.

SPECIFICATIONS:

Connectors: DB25 plug on 80mm ribbon cable and DB25 socket.

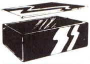
Indicators: Tricolour LED's for TD, RD, RTS, CTS, DSR, CD, TC, RC, DTR, (E)TC.

Jumper Wires: 20 pieces.

Power: Interface power.

Dimensions: 85 x 95 x 30mm

X15700 .... **$94.95**



UTILITY BOXES

Plastic boxes with aluminium tops, and available in four sizes. Very popular for projects and very ecconomical!

H10101	150x90x50mm..	**$ 3.25**
H10102	195x113x60mm.	**$ 4.50**
H10103	130x68x41mm..	**$ 2.75**
H10105	83x54x28mm....	**$ 1.95**
H10110	120x65x38mm...	**$ 2.95**
H10112	120x65x38mm... (Metal top)	**$ 2.95**

MASTER RACK MOUNTING CABINETS

These superb rack mount cabinets will give your projects a real professional appearance!

Just look at these features...

- All dimensions conform to the International Standard
- All aluminium construction
- Choice of black or natural finish
- Deluxe brush finish anodised front panel
- Removeable top and bottom lid
- Ventilated lid

Horizontal Depth: 254mm

A = External front panel height mm

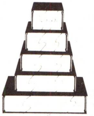
B = Mounting hole centres mm

C = Internal chassis height mm

A	B	C	Finish	Cat.No.	Price
44	34	38	Natural	H10401	**$59.50**
88	57	82	Natural	H10402	**$69.50**
132	89	126	Natural	H10403	**$79.50**
44	34	38	Black	H10411	**$65.00**
88	57	82	Black	H10412	**$75.00**
132	89	126	Black	H10413	**$85.00**

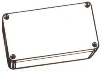
HORWOOD ALUMINIUM CASES

H10382	3 x 4 x 2 inches	**$ 5.50**
H10383	3 x 4 x 3 inches	**$ 6.50**
H10384	3 x 4 x 4 inches	**$ 7.50**
H10385	3 x 4 x 5 inches	**$ 7.95**
H10386	3 x 4 x 6 inches	**$ 8.50**
H10387	3 x 4 x 7 inches	**$ 9.50**
H10388	3 x 4 x 8 inches	**$10.50**
H10389	3 x 4 x 9 inches	**$10.95**
H10390	3 x 4 x 10 inches.	**$11.95**



HORWOOD METAL INSTRUMENT CASES (ROUND HANDLES)

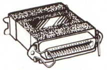
84/6/V	H10461	153 x 102 x 203mm	**$18.95**
84/8/V	H10462	203 x 102 x 203mm	**$19.50**
84/10/V	H10463	254 x 102 x 203mm	**$19.95**
84/12/V	H10464	305 x 102 x 203mm	**$22.95**



DIECAST BOXES

Diecast boxes are excellent for RF shielding, and strength.
Screws are provided with each box.

H11451	100 x 50 x 25mm...	**$ 5.95**
H11452	110 x 60 x 30mm...	**$ 6.50**
H11453	120 x 65 x 40mm...	**$ 6.95**
H11461	120 x 94 x 53mm...	**$11.50**
H11462	188 x 120 x 78mm..	**$13.50**
H11464	188 x 188 x 64mm..	**$29.50**



CENTRONICS GENDER CHANGERS

- Female to Female.
- Saves modifying or replacing non-mating Centronics cables.
- All 36 pins wired straight through.

Cat.X15663	**Male to Male**
Cat.X15661	**Male to Female**
Cat.X15664	**Female to Female**

Normally $33.95,

.... **Only $24.95**

RS232 GENDER CHANGERS

- Saves modifying or replacing non-mating RS232 cables.
- All 25 pins wired straight through

Cat.X15650	**Male to Male**
Cat.X15651	**Male to Female**
Cat.X15652	**Female to Female**

Normally $14.95 each

Only $9.95ea

DB15 GENDER CHANGERS

- Saves modifying or replacing non-mating DB15 connections
- All 15 pins wired straight through

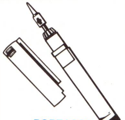
X15645:	**Male to male**
X15646:	**Male to Female**
X15647:	**Female to Female**

.... **only $14.95**

ECONOMY ANTISTATIC SOLDER SUCKER

- Light weight
- Sturdy construction
- Easy to remove tip
- Excellent value for money!

Cat. T11281 .... **$13.95**



PORTASOL PROFESSIONAL

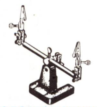
- Four tools in one: Blow Torch, Hot Blow, Hot Knife
- No Cords or batteries
- Heavy duty, tip temperature adjustable up to 400°C.
- Equivalent to 10-60 watts
- Hard working. Average continuous use 90 minuters
- Refills in seconds
- Powered by standard butane gas lighter fuel
- Range of easily replaceable screw tips included
- Includes metal stand for the soldering iron when working
- Cap features built-in flint for igniting Portasol tip
- Includes snap case for storage

Cat. T12639 .... **$89.95**

AUTOMATIC CABLE STRIPPER

- Strips cable with diameter of 1 1·6 2 2·6 3·2mm
- Fully automatic action. Squeeze grip will simulataneously strip and eject insulation.
- Length 180mm (7")

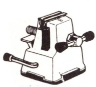
T11532 .... **$19.95**



PC BOARD HOLDER

Better than an extra pair of hands! A must for all PCB work.

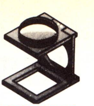
Cat. T12444 .... **$9.95**



MINIATURE HOBBY VICE

- Lever operated suction grip base for instant mounting and portability
- Mounts on smooth non-porous surfaces.
- Ideal for holding components, and other small/light objects.

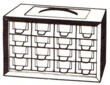
Cat.T12458 **only $6.45**



FREE STANDING, FOLD UP MAGNIFIER

An economically priced "hands free" magnifier, lets you take care of all those tricky fine detailed jobs so often encountered in electronics, or any of many other practical uses such as home, work, hobbies etc.

T10020 .... **$12.95**



PORTABLE 16 DRAWER CABINET

- Overall size: 270(L) x 160(W) x 165(H)mm
- Drawer size: 142(L) x 56(W) x 31(H)mm
- Metal case, clear plastic drawers
- Carry strap
- Stackable or wall mountable

H10085 .... **$19.95**

METEX 3800 MULTIMETER

This instrument is a compact, rugged, battery operated, hand held 3½ digit multimeter for measuring DC and AC voltage, DC and AC current. Resistance and Diode, for testing Audible continuity and transistor hFE. The Dual-slope A-D Converter uses C-MOS technology for auto-zeroing, polarity selection and over-range indication. Full overload is provided. It is an ideal instrument for use in the field, laboratory, workshop, hobby and home applications.

Features...

- Push-button ON/OFF switch.
- Single 30 position easy to use rotary switch for FUNCTION and RANGE selection.
- ½" high contrast LCD.
- Automatic over-range indication with the "1" displayed.
- Automatic polarity indication on DC ranges.
- All ranges fully protected plus Automatic "ZERO" of all ranges without short circuit except 200 ohm Range which shows "000 or 001"
- High Surge Voltage protection 1.5 KV-3 KV.
- Diode testing with 1 mA fixed current.
- Audible Continuity Test.
- Transistor hFE Test.

SPECIFICATIONS

Maximum Display: 1999 counts 3½ digit type with automatic polarity indication.

Indication Method: LCD display.

Measuring Method: Dual-slope in A-D converter system.

Over-range Indication: "1" Figure only in the display.

Temperature Ranges: Operating 0◦C to +40◦C

Power Supply: one 9 volt battery (006P or FC-1 type of equivalent)

Cat.Q91530 .... **Normally $109**

SPECIAL $79

NOW OPEN IN SYDNEY!

74 PARRAMATTA RD, STANMORE
PHONE (02) 519 3134

ARLEC ELECTRIC HEAT & STRIP HOT AIR GUN

FEATURES:
- Dual temperature range (400°C and 600°C)
- Powerful 1600 Watt output
- High airflow rate
- Built in safety handle
- Hanging hook for storage or stand for hands-free use
- 12 month construction

Ideal For....
- Stripping paint and varnish
- Bending and moulding plastic pipes
- Removing vinyl, lino, carpet tiles and glue
- Heat shrinking PVC tubing and wrapping
- Thawing frozen metal water pipes
- Loosening rusted or over tightened nuts
- Drying out damp materials such as timber, paint, putty and fillers
- Soft soldering sheetmetal and pipe connectors

T12309 .... **$60.75**

METEX 3530 MULTIMETER

This instrument is a compact, rugged, battery operated, hand held 3½ digit multimeter for measuring DC and AC voltage, DC and AC current, Resistance and Diode, Capacitance, Transistor hFE and Continuity Test. The Dual-slope A-D Converter uses C-MOS technology for auto-zeroing, polarity selection and over-range indication. Full overload is provided. It is an ideal instrument for use in the field, laboratory, workshop, hobby and home applications.

Features...
- Push-button ON/OFF switch.
- Single 30 position easy to use rotary switch for FUNCTION and RANGE selection.
- ½" high contrast LCD.
- Automatic over-range indication with the "1" displayed.
- Automatic polarity indication on DC ranges.
- All ranges fully protected plus Automatic "ZERO" of all ranges without short circuit except 200 ohm Range which shows "000 or 001".
- High Surge Voltage protection 1.5 KV-3 KV.
- Capacitance measurements to 20uF
- Diode testing with 1 mA fixed current.
- Audible Continuity Test.
- Transistor hFE Test.

SPECIFICATIONS

Maximum Display: 1999 counts 3½ digit type with automatic polarity indication.

Indication Method: LCD display.

Measuring Method: Dual-slope in A-D converter system.

Over-range Indication: "1" Figure only in the display.

Temperature Ranges: Operating 0°C to +40°C

Power Supply: one 9 volt battery (006P or FC-1 type of equivalent)

Cat. Q91540 .... **Normally $139**

SPECIAL $109

HAKKO 926 SOLDERING STATION

Quality, Safety and Performance!

FEATURES:
- Super quick heat up coupled with faster thermal recovery permits high quality soldering at lower tip temperature
- Built in ceramic heater sensor maintains temperatures within 0·5°C of the setting
- Soldering iron grip is heat insulated for operator comfort
- The soldering iron is low voltage 24V, and is completely isolated from the A.C. line by an insulated transformer.
- A full wave zero crossing switch system is utilized to turn heater element ON and OFF
- The soldering tip is connected to earth ground

SPECIFICATIONS

Power Consumption AC100, 110, 120, 240V-60W. Output 24V

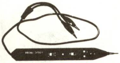
Temperature 200°C to 480°C

Insulation Resistance 50Mohm (480°C)

Leak Voltage under 0·6mV (between tip and ground)

Weight 1·5Kg without cord and iron stand

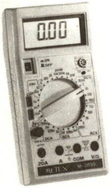
.... **$195**



LOGIC PROBE

Features 20MHZ memory. TTL/CMOS operation.

Cat. Q11272 ...... **$34.50**



METEX M-3650 MULTIMETER

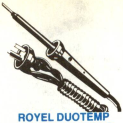
20A, 3½ digit frequency counter multimeter with capacitance meter and transistor tester.

This spectacular, rugged and compact DMM has a bright yellow high impact plastic case. It features a frequency counter (to 200kHz), diode and transistor test, continuity (with buzzer), capacitance meter, up to 20 amp current measurement and comprehensive AC/DC voltage, current and resistance ranges.

CHECK THESE FEATURES....
- Push-button ON/OFF switch.
- Audible continuity test
- Single function, 30 position easy to use rotary switch for FUNCTION and RANGE selection.
- Transistor test
- Diode test
- Quality probes
- ½" High contrast LCD.
- Full overload protection
- 20 Amp
- Built in tilting bail
- Capacitance meter
- Instruction manual

Q91550 .... Normally $165

Special, only $129



ROYEL DUOTEMP SOLDERING IRONS

The DUOTEMP range are designed to idle with a normal tip temperature of 360°C, without its button depressed. In this mode they are ideal for delicate work such as printed circuit boards. With the button depressed, the power is doubled, allowing much heavier work to be completed, or a rapid temperature recovery from larger joins. (Note: This mode cannot be used continuously.) A range of 6 long-life tips are available.

ROYEL DR-30 (21 WATT)

- 3mm tip
- 240V operation, no transformer required
- Safety Standards Approved
- 6 months warranty

Cat T12640 .... **$39.50**

ROYEL DR-50 (30 WATT)

- 5mm tip
- 240V operation, no transformer required
- Safety Standards Approved
- 6 months warranty

Cat T12645 .... **$44.50**

ROYEL DR-60 (40 WATT)

- 6.5mm tip
- 240V operation, no transformer required
- Safety Standards Approved
- 6 months warranty

Cat T12650 .... **$49.50**

METEX 4500H MULTIMETER

10A, 4½ digit multimeter with digital hold, transistor tester and audible continuity tester.

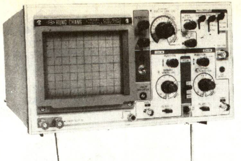
The Metex 4500H is perfect for the technician, engineer or enthusiast who requires the higher accuracy of a 4½ digit multimeter. This meter is exceptionally accurate, (just look at the specifications), and yet, still retains an exceptionally low price!

The Metex 4500H features digital hold which is normally only found on very expensive multimeters. This enables you take a reading and hold that reading on display even after you have removed the probes, simply by pressing the hold button.

CHECK THESE FEATURES...
- Readout hold
- Transistor Tester
- 4½ digit x ½"(H) LCD
- Audible continuity tester
- Push-button ON/OFF switch.
- Quality set of probes
- Single function, 30 position easy to use rotary switch for FUNCTION and RANGE selection.
- Built in tilting bail
- Instruction manual
- Full overload protection
- hFE test
- Battery and Spare fuse
- Diode Tester
- Vinyl case

Q91560 .... Normally $175

Special, only $159



HUNG CHANG (RITRON) 20 MHz DUAL TRACE OSCILLOSCOPE

- **Wide bandwidth and high sensitivity**
- **Internal graticule rectangular bright CRT**
- **Built in component tester**
- **Front panel trace rotater**
- **TV video sync filter**
- **Z axis (Intensity modulation)**
- **High sensitivity X-Y mode**
- **Very low power consumption**
- **Regulated power supply circuit**

COMPONENT TESTER is the special circuit with which a single component or components in circuit can be easily tested. The display shows faults of components, size of a component value, and characteristics of components. This feature is ideal to trouble shoot solid state circuits and components with no circuit power. Testing signal (AC Max 2 mA) is supplied from the COMPONENT TEST IN terminal and the result of the test is fed back to the scope through the same test lead wire at the same time.

CRT

CRT: 6" (150mm) Flat-faced high brightness CRT with Internal Graticule.
Effective display area: 8 x 10 div (1 div = 10 mm)
Acceleration potential: 2KV

VERTICAL

Operating Modes: CH-A, CH-B, DUAL, ADD (CH-B can be inverted.)
Dual modes: Alter; 0.2ufs - 0.5ms/div. Chop; 1ms - 0.5s/div.
CHOP frequency 200KHz approximately.
Deflection factor: 5mV/div 20V/div +/−3%, 12 ranges in 1-2-5 step with fine control.
Bandwidth: DC; DC - 20MHz (−3dB). AC; 10Hz - 20MHz −3dB).
Rise Time: Less than 17ns.
Overshoot: Less than 3%.
Input Impedance: 1M ohm +/−5%, 20pF +/−3pF
Maximum Input Voltage: 600Vp-p or 300V (DC+AC Peak).
Channel Isolation: Better than 60 dB at 1KHz.

HORIZONTAL

Sweep Modes: NORMAL, and AUTO
Time Base: 0.2ufs - 0.5s/div +/−3%. 20 ranges in 1-2-5 step with fine control.
Sweep Magnifier: 5 times (5X MAG).
Linearity: 3%.

TRIGGERING

Sensitivity: INTERNAL: 1 div or better for 20Hz - 20MHz (Triggerable to more than 30MHz). EXTERNAL: 1Vp-p or better for DC - 20MHz (Triggerable to more than 30MHz).
Source: INT, CH-A, CH-B, LINE and EXT.
Slope: Positive and Negative, continuosly variable with level control PULL AUTO for free-run.
Coupling: AC, HF-REJ and TV. TV SYNC Vertical and Horizontal Sync Separator Circuitry allows any portion of complex TV video waveform to be synchronized and expanded for viewing TV-H (Line) and TV-V (Frame) are switched automatically by SWEEP TIME/DIV switch.
TV-V:0.5s/div to 0.1ms/div. TV-H:50ufs/div to 0.2ufs/div.

X-Y OPERATIONS

X-Y Operations: CH-A: Y axis. CH-B: X axis Highest Sensitivity: 5mV/div.

COMPONENT TESTER

Component Tester: Max AC 9V at the terminal with no load. Maximum current 2mA when the terminal is shorted. (Internal resistance is 4.7K ohm)

OTHER SPECIFICATIONS

Intensity Modulation: TTL LEVEL (3Vp-p); Positive ...... brighter.
BANDWIDTH; DC-1MHz Maximum Input Voltage: 50V (DC+AC Peak)
Calibration Voltage: 0.5Vp-p +/−5%, 1KHz +/−5% Square wave.
Trace Rotation: Electrically adjustable on the front panel.
Power Requirements: AC; 100, 120, 220, 240V 20W
Weight: 7kg approximately.
Size: 162(H) x 294(W) x 352(D)mm.

Cat. Q12105 .... **only $895**

(tax exempt only $775)

Bulk orders, schools, and tax exempt inquiries, please phone (03) 543 2166 for special low pricing.

ROD IRVING ELECTRONICS

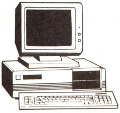
ROD IRVING ELECTRONICS

DATA TRANSFER SWITCHES

If you have two or four compatible devices that need to share a third or fifth, then these inexpensive data transfer switches will save you the time and hassle of constantly changing cables and leads around.

- No power required
- Speed and code transparent
- Two/Four position rotary switch on front panel
- Three/Five interface connections on rear panel
- Switch comes standard with female connector

2 WAY RS232	X19120	**$69**
4 WAY RS232	X19125	**$79**
2 WAY Centronics	X19130	**$69**
4 WAY Centronics	X19135	**$79**



IBM* XT* COMPATIBLE COMPUTERS FROM $995

Check these features and our prices. We're sure you'll agree they're exceptional value for money!

- Final assembling and testing in Australia!
- Fast TURBO Motherboard
- AT* style keyboard
- Tested by us for 24 hours prior to delivery!
- 8 Slot motherboard
- 12 months warranty!
- 150W power supply

*$995 WORKSTATION COMPATIBLE COMPUTER

256K RAM, Single Drive, Graphics and Disk Controller Card. ... **$995**

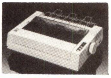
640K RAM TURBO COMPATIBLE COMPUTER

2 x 360K Disk Drives, Multifunction Card, Colour Graphics, Disk Controller, 1 Serial, Parallel Port. (Includes Timer Disk). **$1,195**

WITH 20 M/BYTE HARD DISK:
& single 360K Disk Drive . **$1,495**
& dual 360K Disk Drives .. **$1,695**

WITH 40 M/BYTE HARD DISK:
& single 360K Disk Drive . **$1,695**
& dual 360K Disk Drives .. **$1,895**

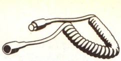
WITH 80 M/BYTE HARD DISK:
& single 360K Disk Drive ... **CALL**
& dual 360K Disk Drives .... **CALL**



PANASONIC KX-P1081 DOT MATRIX PRINTER

- 120 C.P.S.
- Pica or Elite character set
- Print Modes: NLQ, Dot Graphics, Draft, Proportional Font.
- Reliable and Compact
- Proportional Printing
- Logic Seeking
- 1K Printer Buffer

C20035 ...... **ONLY $379**



KEYBOARD EXTENSION LEAD

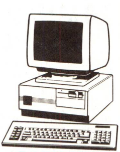
P19038 .... **$6.95**

COMPUTER EXTENSION POWER LEAD

P10254 .... **$11.95**

MONITOR EXTENSION LEAD

P19032 .... **$21.50**



BABY AT* COMPATIBLE COMPUTER!

2 M/BYTE $2,695

- Final assembling and testing in Australia!
- 4 M/Byte Main Board, 2 M/Byte installed
- Switchable 8/10/12 MHz
- 1.2 M/Byte Floppy Disk Drive
- 80286 CPU
- Colour Graphics Display Card
- 8 Slots
- Floppy & Hard Disk Controller
- Printer Card and RS232
- Keyboard
- 200W Power Supply
- Manual
- 6 Months Warranty
- Size: 360(W) x 175(H) x 405(D)mm

With 20 M/Byte Hard Disk $2,695
With 40 M/Byte Hard Disk $2,895
With 80 M/Byte Hard Disk CALL

MAIL ORDER HOTLINE
008 335757
(TOLL FREE)
LOCAL: 543 7877

PRINTER RIBBONS TO SUIT:

CP80, SX80, DP80, BX100 MB100

1-9		10+
$8.95	(C22036)	**$7.95**

MX/80 FX/80 RX/80

1-9		10+
$8.95	(C22031)	**$7.95**

MX100, FX100, RX100

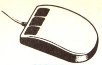
1-9		10+
$19.95	(C22002)	**$18.95**

LX80

1-9		10+
$9.95	(C22003)	**$8.95**

LQ1000

1-9		10+
$27.60	(C22012)	**$25.00**

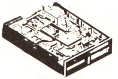


MOUSE

MICROSOFT* COMPATIBLE!

- Auto-Selection and Auto-Transfer between Mouse System PC Mouse Mode and Microsoft Serial Mouse Mode
- Microsoft Serial Mouse and Mouse System compatible
- Super high tracking speed: 600mm/sec
- Super high resolution: 200 D.P.I. (0·12mm/dot)
- Silicon rubber coated ball
- Optical rotary encoder

Cat.X19952 .... **$94.95**



QUALITY JAPANESE DRIVES!!

5¼" 500K DRIVE

- 360K formatted,
- IBM* XT* compatible

Cat.C11901 .... **$239**

5¼" 1·2 M/BYTE DRIVE

- 720K formatted
- IBM* AT* compatible

Cat.C11906 .... **$269**

3½" 1 M/BYTE DRIVE

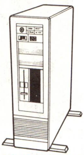
- 720K formatted
- Double sided, double density
- 5¼" mounted

Cat. C11909 .... **$269**

3½" 2 M/BYTE DRIVE

- 1·44 M/Byte formatted
- Double sided, double density
- 5¼" mounted

Cat. C11911 .... **$299**



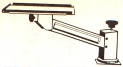
386 TOWER PC

The 386 Tower PC is a high performance system that's IBM*AT* compatible. However, the 386 Tower PC gives you 2-5 times the performance.

FEATURES:

- Intel 80386-16MHz microprocessor
- Switchable 16/20 MHz
- 2 M/Byte fitted. Total memory expandable up to 16 M/Bytes.
- Up to 2 M/Byte or 8 M/Byte RAM modules on system board or on RAM card
- Option for 80287 & 80387 co-processor socket
- Operates in page mode with interleave memory subsystem
- Shadow RAM supported to allow system BIOS to be executed on system memory instead of slower EPROM
- Four 16-bit I/O slot. Three 8-bit I/O slot, and one 32-bit memory slot.
- 8042 keyboard controller interface for AT* compatible keyboard
- Seven direct memory access (DMA) channels
- Chips and Technology chip set
- AMI 386 BIOS/Phoenix 386 BIOS/ AWARD 386 BIOS (AMI fitted)
- 50 M/Byte hard disk. 42 M/Byte formatted. Fast access.
- EGA card

.... **$5,995**



MONITOR MOVER ARM

Position your monitor exactly where you want it! Place your monitor in an ideal working position, or out of your way when you're not using it. Maximise desk space!

- Solid steel structure
- Height adjustment by knob (3cm - 27cm)
- Span 33cm
- Tray 30cm (tilting + – 15°
- Desk clamp range 3cm - 7·5cm
- Maximum load 50kg

C21079 .... **$159**

APPLE* COMPATIBLE SLIMLINE DISK DRIVE

Compatible with Apple 2+
Cat. X19901 . **Only $179**

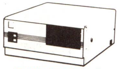
FREE PACK OF S/S DISKS WITH EACH DRIVE!

APPLE* IIC COMPATIBLE DISK DRIVE

(including cable ..... **only $199**

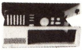
FREE PACK OF S/S DISKS WITH EACH DRIVE!

(*Apple is a registered trade mark.)



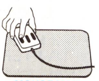
BABY AT* STYLE COMPUTER CASING

Compact foot space. Features security key switch, 8 slots, and mounting accessories.
Size: 360(W) x 175(H) x 405(D)
Cat.X11093 .. **ONLY $99**



IBM* XT* COMPATIBLE CASE

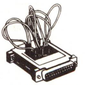
XT* size and styling. Features security key switch, 8 slots, and mounting accessories.
Size: 490(W) x 390(D) x 140(H)
Cat. X11090 ... **only $69**



MOUSE MAT

- A quality mouse mat for accurate and comfortable tracking
- Anti-static
- 265 x 225mm

C21075 .... **$9.95**



RS232 WIRING ADAPTOR BOX

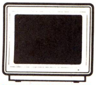
- Male to female
- 25 Detachable plug on leads
- 2 mini jumpers
- Ideal for experimenting or temporary connections

Cat. X15665 .... **Normally $49.95**
Only $44.95

DELUXE PRINTER STAND

- Restores order to your work area without occupying extra space.
- Feeds and refolds paper under the printer automatically.
- Adjustable paper deflectors to ensure smooth flow of paper.
- Made of moulded plastic
- Suitable for most printers

C21058 80 column **$79.95**

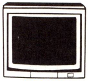


GOLDSTAR 20MHz COMPOSITE MONITOR

X14516 AMBER **$109**

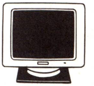
GOLDSTAR 12" TTL MONITOR

X14502 AMBER **$119**



RITRON CGA COLOUR MONITOR

Quality monitors without the exorborant price tag!
Display Tube: 14 inch 90° deflection 0·39mm Dots trio pitch. Dark face screen
Phosphor: P22
Resolution: 640 dots (horizontal) 240 line (vertical)
.... **only $445**

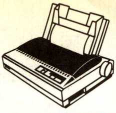


RITRON EGA COLOUR MONITOR

Quality monitors without the exorborant price tag!
Display Tube: 14 inch 90° deflection dot type black matrix. Standard persistence phosphor
Active Display Area: 240 x 180mm
Resolution:
64 Colour: 720 dots(H) x 350 lines
16 Colour: 640 dots(H) x 200 lines
.... **only $645**

RITRON MULTISYNC VGA COLOUR MONITOR

Quality Auto VGA, EGA, CGA monitor without the high price tag!
Display Tube: 14 inch 90° deflection P22 Non-glare, tint. 0·31mm Dot pitch,
Active Display Area: 245 x 185mm
Resolution: 800 dots(H) x 600 lines(V)
Display Colour: TTL input
TTL input: 8/16/64 colours
Analog input: unlimited colours
.... **only $945**



STAR NX1000 PRINTER

- 144 c.p.s. high speed draft printing
- 36 c.p.s. NLQ printing
- 8 built-in NLQ fonts
- Proportional printing available in all font styles
- Convenient push button control panel
- Paper parking mechanism
- Tractor and friction feeds standard
- Standard parallel interface
- Two emulation modes: IBM Proprinter II, EPSON ESC/P

C22049 .... **$495**

ROD IRVING ELECTRONICS

All sales tax exempt orders and wholesale inquiries to:
RITRONICS WHOLESALE,
56 Renver Road, Clayton.
Phone: (03) 543 2166 (3 lines)
Fax: (03) 543 2648

SYDNEY: 74 Parramatta Rd.
Stanmore. 2048.
Phone (02) 519 3134
Fax (02) 519 3868

MELBOURNE: 48 A'Beckett St.
Phone (03) 663 6151

NORTHCOTE: 425 High St.
Phone (03) 489 8866

CLAYTON: 56 Renver Rd.
Phone (03) 543 7877

MAIL ORDER & CORRESPONDENCE:
P.O. Box 620, CLAYTON 3168
Order Hotline: 008 33 5757
(Toll free, strictly orders only)
Inquiries: (03) 543 7877
Telex: AA 151938
Fax: (03) 543 2648

ORDER HOTLINE
008 335757
(TOLL FREE)

STRICTLY ORDERS ONLY

LOCAL ORDERS & INQUIRIES
(03) 543 7877

POSTAGE RATES:

$1 – $9.99	**$2.00**
$10 – $24.99	**$3.00**
$25 – $49.99	**$4.00**
$50 – $99.99	**$5.00**
$100 plus	**$7.50**

The above postage rates are for basic postage only. Road Freight, bulky and fragile items will be charged at different rates.

Errors and omissions excepted. Prices and specifications subject to change.

IBM*, PC*, XT*, AT*, are registered trademarks of International Business Machines. *Apple is a registered trademark. *Denotes registered tradmarks of their respective owners.

bankcard MasterCard VISA

ROD IRVING ELECTRONICS No.1 FOR DISCOUNT PERIPHERALS!

20 M/BYTE HARD DISK

Drive with controller card. IBM* compatible. 12 month warranty.
X20010 ...... **ONLY $449**

42 M/BYTE HARD DISK

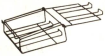
IBM* compatible. 50 M/Byte unformatted. 12 month warranty.
Without controller .. **$595**
With controller **$695**

80 M/BYTE HARD DISK

IBM* compatible. 12 month warranty
X20030 ...... **Please call**

50 M/BYTE VOICE COIL HARD DISK

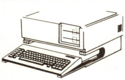
Capacity: 50·5 M/Byte unformatted
Access Time:
Track to track: 6 ms
Average 28 ms
Full span 52 ms
Size: 146(W) x 41(H) x 203(D)
C20008 **$1,100**



PRINTER STANDS

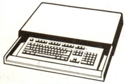
- Restores order to your work area.
- Conveniently stacks paper printout in document tray automatically
- Made of black plastic coated steel
- Suitable for most printers
- Excellent value at this price!

C21056 .... **$29.95**



KEYBOARD SLIDE-AWAY

Slide your keyboard neatly away when not in use. Gives you more desk space. Securely holds any keyboard, wide or narrow.
C21083 ..... **Only $64.95**



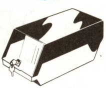
KEYBOARD STORAGE DRAWER

Stores keyboard under the PC or monitor conveniently out of the way. Fits PC/AT keyboard or 2¾"(H) x 22¼"(W) x 9½"(D)
C21081 (YU-E21B) **$84.95**

DATALIFE DL-600 DATA CARTRIDGE

Stores up to 120 M/Byte
C12614 .... **$99.95**

MAIL ORDER HOTLINE
008 335757
(TOLL FREE)
LOCAL: 543 7877



5¼" DISK STORAGE (DD100-L)

Efficient and practical. Protect your disks from being damaged or lost!
Features...
- 100 x 5¼" disk capacity
- Smoked plastic hinged lid
- Lockable (2 keys supplied)
- High impact ABS plastic base.
- Contemporary design

C16020 .... **only $15.95**

3½" DISK STORAGE (DD80-L)

- Holds up to 80 x 3½" diskettes.
- Smoked plastic hinged lid
- Lockable (2 keys supplied)
- High impact plastic base
- Contemporary design

C16038 ..... **only $19.95**

3½" DISK STORAGE

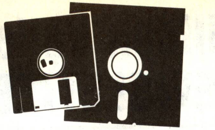
- Holds up to 40 x 3½" diskettes.
- Lockable (2 keys supplied)
- High impact plastic lid and base

C16035 ..... **only $14.95**

PRINTER LEAD

- Suits IBM* PC/XT, compatibles
- 25 pin "D" plug (computer end) to Centronics 36 pin plug

P19029	(1.8 metres)	**$14.95**
P19030	(3 metres) ...	**$19.95**
P19032	(9·5 metres) .	**$39.95**



"NO BRAND" DISKS!

Now you can buy absolute top quality disks that are also the cheapest in Australia! They even come with a lifetime warranty, which indicates the quality of these disks. So why pay 2-3 times the price for the same quality?

Packs of 10, D/S D/D without boxes, or brand name, just their white paper jacket, and index labels. (5¼" disks includes write protects).

5¼" 2S/2D "NO BRAND" DISKS

10+DISKS	100+DISKS	1,000+DISKS
$6·95ea	**$6·75ea**	**$6·50ea**

(ALL PRICES PER 10 DISKS)

5¼" HIGH DENSITY DISKS

(DOUBLE SIDED)

10+DISKS	100+DISKS	1,000+DISKS
$21ea	**$20ea**	**$19ea**

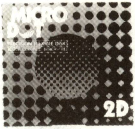
(ALL PRICES PER 10 DISKS)

3½" 2S/2D "NO BRAND" DISKS

Suitable for IBM, PS/2, Macintosh, Atari, etc.

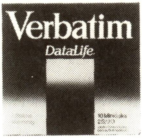
$21

(ALL PRICES PER 10 DISKS)



MICRODOT DISKS!

DESCRIPTION	1-9 BOXES	10+ BOXES
3½" 2S/2D	**$23.95**	**$22.95**
5¼" 2S/2D	**$11.95**	**$10.95**
5¼" 2S/HD	**$21.00**	**$20.00**



VERBATIM DISKS!

(ALL PRICES PER BOX OF 10 DISKS)

DESCRIPTION	1-9 BOXES	10+BOXES
3½" 1S/2D	**$39.95**	**$37.95**
3½" 2S/2D	**$46.95**	**$43.95**
3½" 2S/HD	**$99.00**	**$89.00**
5¼" 1S/2D	**$22.00**	**$21.00**
5¼" 2S/2D	**$26.00**	**$24.00**
5¼" 2S/4D	**$75.00**	**$70.00**
5¼" 2S/HD	**$41.00**	**$39.00**

ROD IRVING ELECTRONICS

Silicon Valley NEWSLETTER . . .

VSLI Technology's new fab plant in Arlington (San Antonio), Texas.

VLSI set to resume growth as new fab comes on-line

San Jose semiconductor firm VLSI Technology found its growth crimped in 1988, a boom year for the industry, because its existing factory was already working overtime. However it has now opened a brand-new, state-of-the-art plant in San Antonio, Texas.

The $US70 million plant is now making chips for sale, and Silicon Valley's fifth-biggest chip maker said it expects to launch a new round of growth and profitability.

"All the things we need in place are now in place, so we're in a great position for next year," said Ken Goldman, vice president of finance. "There is a crying need in the US for leading-edge capability, so we're going to be in a good position this year".

But some analysts question how good the company's position will be. For one thing, they believe the shortage of leading-edge chip fabrication facilities, or "fabs," will ease considerably this year. For another, although VLSI Technology is one of the few chip makers to open a new fab, many chip makers have been buying advanced equipment that allows existing plants to use the most up-to-date technology.

"Demand at the leading edge is still exceeding supply today," said Dan Hutcheson, president of VLSI Research, a San Jose market research firm that tracks the semiconductor equipment industry. "But shortly we should really see it loosen up."

Analysts also believe industry growth will slow considerably, from nearly 40% growth last year to about 10% in 1989.

VLSI Technology, which said it has plenty of new orders for chips, believes it can make and sell $US75 million in chips in the new plant alone next year. "We have a lot of pent-up demand that we haven't supported out there, " Goldman said.

Texas gets $US4 billion Supercollider

The three year bitterly-fought battle over the awarding of the $US4 billion Supercollider project has come to an end, as the US government announced it had chosen a site 20 miles north of Dallas, Texas to build the huge facility – which includes a 53-mile oval tunnel which will be able to hurl atomic particles at each other, at forces 20 times greater than any of today's colliders. The award is the second major technology research project to be awarded to Texas within a year, after the chip industry's Sematech research consortium selected Austin as its permanent site last year.

The collider, to be known as the Ronald Reagan Centre of High-Energy Physics, will cost in excess of $US4 billion to construct. When completed it will add more than a billion in annual payroll and some 8,000 jobs to the sagging Texas economy, which has been hurt badly in recent years due to the crisis in oil prices.

Government officials and scientists said the supercollider will enable researchers to create head-on collisions between protons each travelling in opposite directions at the speed of light. With the supercollider, scientists hope to more clearly identify all of the subatomic particles that make up protons and neutrons, the basic building blocks of all material in the universe.

The understanding of the composition of these subatomic particles could lead to new discoveries in a broad range of technologies, including the medical fields, electronics, weapons research and energy.

No colour laptops until next decade, panel concludes

Despite the promise of new flat-panel display technologies such as Active Matrix LCDs, it will be at least 1990 or later before the first colour laptops will appear on the market, according to the conclusions of panelists at a Santa Clara high-tech convention.

For the time being, the only flat-panel colour displays will be found in small portable televisions and video-cassette players. The first flat-panel colour displays for laptops probably won't go into production until late 1990, according to Stanford Resources which has conducted a survey on the issue.

But by late 1991, according to panelist James Bartlett of NEC, some 46% of laptop buyers will demand colour displays.

Those buyers are likely to have to pay a big premium for their colour displays he added. While colour CRTs cost only a little bit more to produce than monochrome CRTs, the flat-panel colour displays will cost significantly more for the foreseeable future.

"I don't expect colour to be economical at first," said panelist Andrew Czernek, vice president of product marketing at Zenith Data Systems.

On the monochrome side, however, flat-panel display and production technology have made major advances in the past two years, which are expected to result in pent-up demand for laptops during the coming years.

Currently, only 7% of all personal computers sold are laptops, a figure that may increase sharply during the next two years according to Bartlett. About 1.4 million laptops are expected to be sold in 1989 according to Dataquest, and Czernek added that he expects that one out of every three personal computers sold in 1991 will be laptops.

AEG takes 39% stake in valley chip maker

Santa Clara chip maker Siliconix announced it has formed a major partnership with Daimler-Benz's AEG Telefunken subsidiary. Under the terms of the agreement, the West German conglomerate will acquire a 39% stake in Siliconix and participate in joint chip research.

As part of the agreement, Westinghouse Electric will sell its block of 4.2 million Siliconix shares, about 34% of the company's outstanding shares to AEG for about $8 per share, or roughly $US30 million.

In addition, AEG will pay Siliconix $US10 million for newly-issued stock, plus an option to buy an additional $10.5 miilion worth of stock within the next year.

At Siliconix, vice president Peter Webber emphasized that the deal does not involve any change in management at Siliconix, a major supplier of power semiconductors.

The Siliconix deal is but the latest in AEG's increasing US high-tech investment portfolio. Recently AEG formed a joint venture with Westinghouse to combine the two firms' transportation businesses. Earlier last year, AEG also paid $US290 million for Gould's Industrial Automation Systems Division, since renamed "Modicon".

Honeywell produces first 0.5 micron VHSIC chip

Honeywell's Solid State Electronics Division in Colorado Springs has announced a major breakthrough in the development of next-generation VHSIC (very high-speed IC) technology, as researchers have successfully built and tested a PiBus interface chip using fully scaled 0.5 micron technology.

The PiBus is designed to become the standard interface bus on the Pentagon's ATE, A-12, and LHX weapons programs.

The development of the chip was part of the Phase II of the VHSIC program which has been under way since 1981.

The circuit contains 150,000 circuit elements in an area of just 0.1 square inch. Besides minimum features of 0.5 microns, the chip's elements are connected by circuit lines measuring just 0.7 microns across, and the component is produced with the industry's first four-metal-layer process.

The first application of the technology will be in a new cruise missile under development, and the first chips will contain more than 250,000 elements.

Harris to pay $US200 million for GE's chip operations

Harris Seimiconductor has announced it has formally agreed to buy General Electric's semiconductor manufacturing operation for $US200 million in cash.

Industry analysts said they were surprised by the price, which was considerably lower than they had speculated on in August when a tentative agreement for the sale of GE Solid State was first announced. At the time, Harris and GE officals refused to disclose the sale price.

Even at the low price, the analysts remain skeptical about the deal as the operation is believed to be operating at break-even at best.

On the other hand, they said if managed properly, GE Solid State could add significant strength to Harris' position in the semiconductor market. Besides leading-edge technology in several areas, GE Solid State, which includes the former Intersil and RCA Semiconductor operations, has a strong presence in the European and other markets outside the United States, an area in which Harris has traditionally been weak.

Varian buys ion implantation firm for $US16 million

Varian Associates in Palo Alto announced it has reached an agreement with Advanced Semiconductor Materials (ASM) of The Netherlands and Eclipse of Massachusetts for the acquisition by Varian of ASM Ion Implant.

Ion Implant, located in Beverly, Massachusetts, which manufactures equipment used in the production of semiconductors, will become part of Varian's Extrion Division which is based in Gloucester in Massachusetts and which makes ion implantation equipment.

Varian said it has agreed to pay

Continued on page 144

Inexpensive PCB Shorts Locator

Here is a simple circuit to help you locate shorted tracks on printed circuit boards, by means of a varying audio tone. It is easily built and will cost you a lot less than equivalent commercial units.

by MARK CHEESEMAN

Two of the most frustrating problems that can arise in the construction of a printed circuit board are broken tracks and shorted tracks. While broken tracks can be easily located using a multimeter or a continuity checker, the same cannot be said for shorts between tracks. Sure, a continuity checker can tell you if a short *exists* between two given tracks, but it falls short of helping you find even the approximate area in which it is located.

The reason for this is quite simple. A continuity checker, by design, indicates whether a circuit exists between the two points to which the test probes are applied, without indicating how 'continuous' the circuit is. PCB tracks usually have a very low resistance, in order that excessive energy is not lost through heating.

This means that virtually any continuity checker will produce the same sound on shorted tracks, no matter how far away from the short the probes are applied. The resistance range encountered on PCBs is far too low for the continuity checker to provide useful resolution. In addition, many continuity checkers make use of piezoelectric buzzers, which tend to oscillate at a fixed frequency, regardless of circuit conditions. Rather, as the impedance of the circuit rises, the volume of the sound from the buzzer tends to decrease, with little or no change in pitch.

The human ear, on the other hand, is much more sensitive to changes in pitch than in sound level, so it would be nice if our instrument translated small changes in resistance to reasonably large changes in pitch.

An audible output is preferable to a visual one (such as a panel meter or digital display) for two reasons. First of all, the cost is significantly lower. But more importantly, it allows the operator to concentrate on the placement of the test prods on the circuit board, and use for input those otherwise wasted sensory organs: the ears.

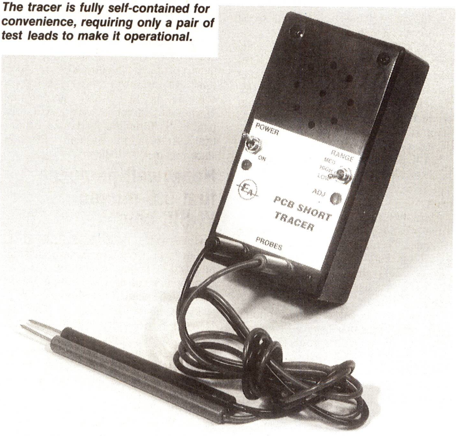
The project presented here achieves these goals, by providing an audible indication of the resistance between the test probes, with a range low enough to resolve the sort of resistances encountered in PCB tracks. In addition, two higher ranges have been provided to allow the same instrument to be used for other applications.

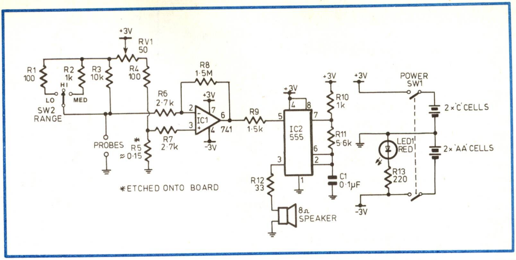
Circuit description

As you can see from the the circuit diagram, there is not that much to it. Two common ICs and a handful of passive components are virtually all that is required.

The circuit can be divided into two sections, each built around one of the ICs. An input amplifier based around a 741 op-amp (IC1) amplifies the differ-

The tracer is fully self-contained for convenience, requiring only a pair of test leads to make it operational.





The circuit is quite simple, based around two common ICs. The external resistance forms part of a Wheatstone bridge, balanced against R5.

ence in voltage across two PCB tracks. One, the reference track, is etched onto the locator's own PCB, while the other is on the circuit board under test, and is connected to the circuit via the test probes.

The part of the circuit consisting of the external PCB track, the internal reference track and the current-determining resistors essentially forms a Wheatstone bridge, the output of which is a small difference in voltage between the centres of the two 'arms' of the circuit.

The current through the probes is determined partly by R1, R2 and R3. R3 is always in circuit, while either R1 or R2 may be connected in parallel with it to increase the current through the probes, and thus set the range of operation of the instrument. RV1 is used to balance the bridge by adjusting the current through both main legs, and is set to give a useful range of output frequencies over the length of track that needs to be tested. This adjustment also helps compensate for the resistance inherent in the test leads themselves.

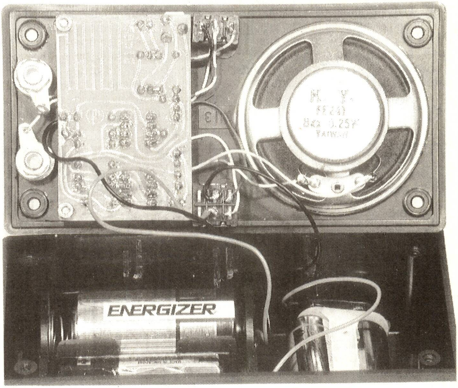
The current through the two arms of the circuit is relatively high, ranging between 20 and 30mA in each arm. This is to ensure consistent readings without being too dependent upon contact pressure. We tried a lower current, but the effects of contact resistance made use of the tracer unpredictable, at best.

IC1 is configured as a differential amplifier, with a gain of about 550, and amplifies the voltage difference appearing across the bridge to a more useful level. This IC operates from a split supply, as its output needs to be able to swing below ground in order to get the maximum possible frequency range from the next stage, the oscillator.

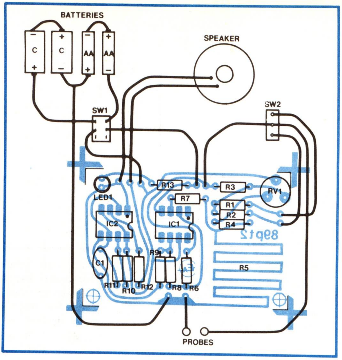
The oscillator is a simple astable configuration based around the ubiquitous 555 timer chip (IC2). The voltages at which the capacitor (C1) starts to charge and discharge are determined by two internal comparators. The reference levels for these comparators are normally determined by three internal 5k resistors, connected as a voltage divider between the supply rails. Thus, the comparators' outputs change state at 1/3 and 2/3 of the supply rail, and so normally the capacitor continuously charges and discharges between 1/3 and 2/3 of the rail voltage.

However, these reference voltages are not fixed, and can be changed by applying an external voltage to pin 5. This shifts the reference voltages up and down between the rails. The lower reference point is the voltage applied to pin 5, and the upper reference voltage is half-way between this voltage and the positive rail, due to the internal resistors.

The result of this is that is very easy to control the frequency at which the 555 oscillates. The effect is anything but linear, but this does not really worry us in this instance. The sensitivity is quite high: for a change of about 50 milliohms, which is about an 80mm length of typical PCB track 1mm wide, the



The PCB mounts behind the front panel, between the switches and banana sockets. The speaker is simply glued in place.



The component overlay and wiring diagram for the tracer. Allow sufficient length in the wires to the battery holders, to enable the lid of the box to be removed without undue strain.

output pitch changes by close to 1kHz. Needless to say this is very easy to detect, even if you're 'tone deaf' in the musical sense!

The value of R9 is chosen so that when IC1 swings as far negative as it can (about -1.5V), the lower comparator reference goes to 0V, and the 555 ceases to oscillate. This occurs whenever the probes are open-circuited, so the checker very conveniently 'shuts up' when it is not actually testing something.

Power is derived from four dry cells, two C-size cells and two AAs. The current drain from the positive rail is much greater than the negative rail, and so there is no need for the larger cells for the negative rail (and no room for them in the box, either!). In fact, you'll probably find the AA cells outlast several changes of the C cells.

A LED is connected as a power indicator, as the fairly solid current drain of the circuit will flatten the battery rapidly if it is inadvertently left on. The LED operates from the negative rail, since the load on this rail is much lower than the positive rail, as noted before.

Construction

Most of the circuit is mounted on a small printed circuit board, coded 89pt2, and measuring 60 x 39mm. Before mounting any components, give the board a quick visual examination to make sure that there are no broken or shorted tracks. You don't have a shorts tracer yet, so this is the best time to check it!

First of all, mount all of the resistors (excluding R5, which is already etched onto the board), and the capacitor. We used a monolithic ceramic of the type commonly used as supply bypasses for C1, on account of its small physical size. A normal metallised polyester (greencap) may be used if you like, by mounting it on its side above the three resistors that are adjacent to it. The height of polyesters is too great to fit in the small space between the PCB and the front panel, if left standing upright.

Finally, mount the trimpot and the two ICs, making sure you get their orientation correct. All of the other components are mounted off the PCB, and are connected by short lengths of hookup wire. Attach suitable lengths to the relevant pads for these components.

The entire project is mounted in an all-plastic jiffy box, measuring 130 x 68 x 41mm. We used a case from Rod Irving Electronics, type H10113, which costs only $2.75.

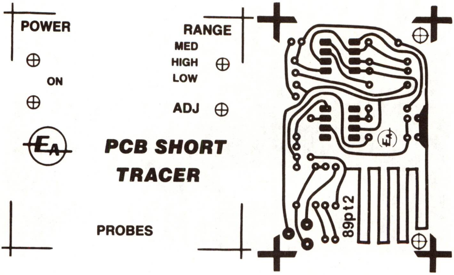
Using a copy of the front panel artwork as a template, stick it to the lid of the box, so that its bottom edge is 12mm from the bottom edge of the lid. Then mark out and drill the holes for the switches, LED and trimmer adjustment.

Next, line the PCB up with the front panel using the LED and trimpot as guides, and mark out the two mounting holes for the board. These holes should then be drilled and countersunk, so that the heads of the 6BA screws lie flush with the panel. Do not actually mount the board yet, though.

The sockets for the test probe leads are mounted below the bottom edge of the Dynamark front panel (adjacent to the 'PROBES' label), and between the lower mounting holes for the lid. Their actual position is not critical, but you should make sure that the solder lugs on the back of the sockets can be arranged so that they do not touch each other on the PCB when it is mounted.

Finally, drill the holes for the speaker 'grille'. Again, the actual size and number is not critical, within the bounds of utility and aesthetic appeal. For the prototype, eight 3mm holes were drilled on the circumference of a 30mm diameter circle, centered 33mm from the top edge of the box, and a further hole in the centre of the circle.

The next step is to mount the two



Reproduced above is the front panel artwork and printed circuit board pattern, both actual size.

countersunk 6BA x 13mm long screws for securing the PCB, and secure them with nuts on the back of the lid. Tighten these well, as the screw heads will be inaccessible once the front panel has been stuck in place. Then attach suitable lengths of wire to the board to connect it to the external components, and mount the board to the front panel, using spacers to leave a gap of about 8mm between the lid and the board.

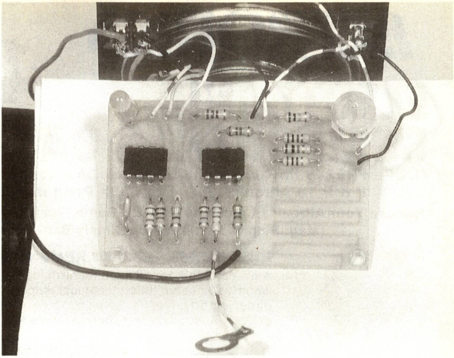
Now, remove the copy of the front panel and mount the stick-on front panel in its place, and carefully cut holes in it with a scalpel or hobby knife, to line up with those already drilled in the box lid.

Mount the switches and sockets, and connect them to the wires trailing from the PCB. The lugs on the back of the switches may need to be trimmed a bit, so that they don't crash into the dry cells when the unit is fully assembled. The speaker may be secured to the lid using an instant adhesive, such as *Supa-Glue*, and also connected to the board.

That completes the construction of the top part of the box. All that remains now is to mount the battery holders for the four cells in the bottom part of the enclosure. We used two separate holders for the two C-cells, but a twin side-by-side holder would also be suitable. Mount the holder(s) in the end of the box that lies underneath the PCB, and secure them to the base of the box using short countersunk 6BA screws and nuts, so that their heads do not protrude beyond the rear surface of the box.

The two AA cells were housed in a twin holder underneath the speaker. This holder may be secured to the box with double-sided tape, but this may make the process of changing the cells difficult when this becomes necessary. Instead, we opted to secure it by placing a small piece of foam rubber between it and the speaker magnet.

Finally connect the battery holders to the rest of the circuit, as shown in the wiring diagram, making sure that you get the polarity correct. Attach the lid to the box, and plug in a pair of multimeter-style test probes.



The assembled PC board, prior to being mounted in the box.

PARTS LIST

1	PC board 60 x 39mm, coded 89pt2
1	plastic jiffy box, 130 x 68 x 41mm
1	front panel, 61 x 61mm
1	DPDT miniature toggle switch
1	SPDT centre-off miniature toggle switch
2	4mm banana sockets
2	single C-cell holders
1	2 x AA-cell holder
1	57mm 8 ohm speaker

Resistors

(all 1/4W, 5%): 1 x 33 ohm, 2 x 100 ohm, 1 x 220 ohm, 2 x 1k, 1 x 1.5k, 2 x 2.7k, 1 x 5.6k, 1 x 10k, 1 x 1.5M

1 50 ohm miniature horizontal trimpot

Capacitors

1 0.1uF monolithic ceramic

Semiconductors

1 741 op-amp
1 555 timer
1 red LED

Miscellaneous

6BA countersunk screws and nuts, hookup wire, solder lugs, solder etc.

Using it

Use of the tracer is simplicity in itself. For locating a short between two tracks on a PCB, turn the unit on (of course!) and select the low range. If you have previously adjusted the trimpot, then it may not need re-adjusting. Otherwise, put the probes on the far ends of a reasonably long track on the board, and with your third hand(!), adjust the trimpot so that the speaker emits a relatively low tone.

Now, hold the prods on the two tracks that are shorted together and gradually move one of the probes along the track, listening to see if the tone from the speaker becomes higher or lower in pitch. If it is higher, then you are going the right way along the track; otherwise you should start heading the other way.

Then, leaving this probe in position, start moving the other one, again noting the pitch emitted by the speaker. By continuing with this line of interrogation, you should eventually home in on the culprit – the exact location of the fault.

When holding the probes onto the board tracks, you should try to maintain a reasonably high pressure, to minimise the effects of contact resistance on the measurements. It helps if the probes are nice and sharp, so you may want to sharpen them especially for the purpose.

The only other source of concern arises in the use of the tester on solder-masked boards, when the probes may not easily penetrate the protective mask covering the tracks. However, shorts between tracks on such a board are relatively unlikely, so you shouldn't normally have to check these boards.

The medium and high ranges are not intended for checking PCB tracks, but were added to the instrument to increase its versatility, by allowing it to be used to test higher resistance circuits such as motor windings, transformer windings and heating elements, for example.

Now, go and find that elusive short!

PHONEORDER TOLL FREE ALTRONICS 008 999 007

BANKCARD • VISA • MASTERCARD PHONE TOLL FREE 008 999 007 NEXT DAY JETSERVICE DELIVERY

BANKCARD • VISA • MASTERCARD PHONE TOLL FREE 008 999 007 NEXT DAY JETSERVICE DELIVERY

ALTRONICS

1989

ELECTRONIC COMPONENTS CATALOGUE

YOURS FREE With This Month's Electronics Australia Magazine OR Send $1 to cover P & P To Altronics, P.O. Box 8350 Perth mail Exchange W.A. 6000

Remove Your Altronics Catalogue Now By Gently Pulling Out From Centre Of Magazine (Mag. Staples Can Then Be Simply Bent Back Into Position)

JACK O'DONNELL
Managing Director

REMEMBER

Altronics Staff are all keen Electronics Enthusiasts — just like yourself — so when you need a little technical help, give us a call • Quality Products at direct import prices • Save up to 50% on our competitors prices • Overnight delivery Australia wide • Bankcard phone order service to 8pm Monday-Friday

FOR THE VERY QUICK!

Here are some incredible bargains. We suggest you phone order now to reserve yours.

Please check inside our Catalogue for full specifications on these items.

Special prices are available on current stocks only, sorry no back orders, strictly "lst come — 1st served".

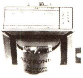
Huge Savings On Top Selling Multipurpose Mains Transformers

Multipurpose 60VA Transformer

Output Two Simple Secondaries, each with just one tap, permit an amazing range of outputs.

240V to 9, 12, 15, 18, 21, 24 volts at 60VA (60W). Use of high grade Silicon steel has enabled surprisingly compact dimensions (70mm x 70mm x 58mm High).

M 2165



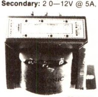
Normally $26.50

$19.00

10 or More $15.00 ea

Multipurpose 120VA Transformer

Another Quality Transformer from Altronics. The M 2175 is wound on expensive grain oriented steel. Look at the size! Just 110mm wide by 65mm High by 65mm Wide. Weight 1.25Kgs. **Primary:** 240V **Secondary:** 1 0—12V @ 5A, 15V @ 4A **Secondary:** 2 0—12V @ 5A, 15V @ 4A.



Normally $39.95

This Month

$30

10 or More $26.00 ea **M 2175**

AA Nicad Sensation

New Improved Performance 500mAH

S 5020 1-9 **$3.00**

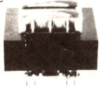
10 Up **$2.50**

PCB Transformer Scoop

240v to 8, 12 or 20V Quality PCB Mount Type Famous Arlec Brand.

Primary: 240V Pins 1,6 - **Secondary 1:** 8V @ 1.6 Amps Pins 7,8 — **Secondary 2:** 12V @ .35 Amps Pins 11, 12 — **Secondary 3:** 20V @ .35 Amps Pins 7, 12 (join 8, 11)

Cat. ZX 0020



Amazing Price 1 — 47

$2.50

48 or More (Carton Lots)

$1.80

Video Modulators Just $2

Video into RF Australian Channel 0 - RF Output - Quality ASTEC Brand.

ZX 0090

1-10 **$3**

10+ **$2**

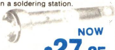
Dozens of applications e.g. • Computer to TV • Video Games • Use your TV as remote Video Monitor • Low cost CRO Adaptor for TV • Video Recorder or Camera to TV etc. etc. All self contained in PC mounting shielded case RCA connector output +12V supply (case neg.) Single terminal wire video input.

Fantastic Value

Temperature Adjustable 250 Deg.C to 450 Deg.C

Excellent new iron, screwdriver temperature adjustable between 250 Deg.C and 450 Deg.C enabling very delicate soldering on low settings with surprising het energy reserve on maximum setting. Relative temperature is indicated by LED lamp brightness. Much lower cost than a soldering station.

T 2445



Normally $37.95

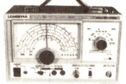
NOW $27.95

$10.00 OFF

RF Signal Generator

SPECIFICATIONS:
Frequency Range: 100KHz - 150MHz in 6 Ranges. **RF Output Level:** 100mV RMS **Accuracy:** +/-3% **Modulation:** • Internal (30% depth **1KHz** • External **50Hz - 20KHz** • Crystal Locked Oscillator.

Q 1550 **SAVE $30**



NOW $195.00
Limited Stocks Be Quick!

Mylar Stereo Phones With Dynamic Mic

Great For 2-Ways, Intercoms P.A.'s & 100 Other Communication uses. Super Comfortable.

Headphone Specs. 20Hz - 20,000Hz, 32 Ohm, 102 db/uW, 3.5mm stereo jack, 6.35mm stereo jack, adaptor. **Microphone Specs.** dynamic type, 300 Ohm, 100Hz - 15,000Hz, -80 db @ 1KHz 3.5mm Mono jack.

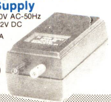
C 9055

SAVE $10.00

NOW $29.95

2 Amp Regulated Power Supply

Input Voltage: 240V AC-50Hz
Output Voltage: 12V DC
Output Current: 2A
Normally **$69.95**



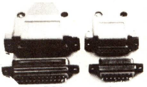
NOW $45

M 9050

Save Up To 50% On Top Quality D Series Connectors!
Fantastic Value

D Series Computer Connectors. Gold Plated Professional Series

Items Marked • are 1/2 Price or Less



		WERE	NOW
DB9			
P 3000	Male 9 Pin	2.95	1.47•
P 3010	Female 9 Pin	3.25	1.60•
P 3020	Male PCB Rt/L	3.75	3.00
P 3030	Fmale PCB Rt/L	4.50	3.50
P 3040	Male PCB mnt.	2.95	2.50
P 3050	Fmale PCB mnt.	3.95	2.25
P 3090	Backshell cover	1.95	.95
DB15			
P 3100	Male 15 Pin	3.25	1.60•
P 3110	Fmale 15 Pin	3.85	1.90•
P 3120	Male PCB Rt/L	4.35	2.10•
P 3130	Fmale PCB Rt/L	5.50	2.70•
P 3140	Male PCB mnt.	3.85	1.90•
P 3150	Fmale PCB	4.85	2.40•
P 3190	Backshell cover	2.20	1.00•
DB25			
P 3200	Male 25 Pin	4.95	2.47•
P 3210	Fmale 25 Pin	5.50	2.74•
P 3220	Male PCB Rt/L	4.95	3.50
P 3230	Fmale PCB Rt/L	6.90	3.90
P 3240	Male PCB mnt.	4.95	3.00
P 3250	Fmale PCB mnt.	6.25	3.95
P 3290	Backshell cover	2.20	1.10•

Dual Cone (8")

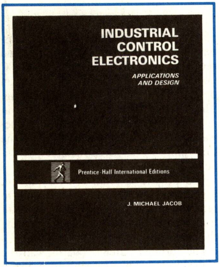
200mm (8") 10 Watts Max. power input. Public Address Background Music. Ideal Hi Fi extension speaker.

C 2000

Normally $16.50
THIS MONTH
$7.50 20+ **$6.00ea**

PHONEORDER TOLL FREE ALTRONICS 008 999 007

Books & Literature



INDUSTRIAL
CONTROL
ELECTRONICS
APPLICATIONS AND DESIGN

Prentice-Hall International Editions

J. MICHAEL JACOB

Industrial control

INDUSTRIAL CONTROL ELECTRONICS: APPLICATIONS AND DESIGN by J. Michael Jacob. Published by Prentice Hall, 1989. Soft covers (student edition) 175 x 230mm, 585 pages ISBN 0-13-459322-7. Recommended retail price $34.95.

Books on control systems can rarely get by without their Laplace transforms, and this one is no exception. The section on Laplace transforms forms part of the appendix, so the presumption by the author is that readers are familiar with this mathematical aspect of control theory.

The book is clearly aimed at those studying at certificate level (TAFE) or any similar level course, and uses calculus as freely as Laplace transforms – which figures, as they are closely related anyway.

The first chapter outlines the principles of closed loop control, and includes details of actual transducer devices, which gives the book a feeling of reality in a topic that can become rather mathematical. Transducers are then dealt with in detail in chapter 3, followed by a chapter on instrumentation amplifiers.

PID (proportional-integral-derivative) control is covered in chapter 5, using operational amplifier circuits as the controllers. Data acquisition is presented in chapter 6, covering the usual analog to digital converters (ADCs) one would expect to find in such applications. Digital control is also discussed in this chapter, with a section on programmable logic controllers (PLCs). Thyristor devices feature in chapter 7 and the whole nasty business of system response fills the remaining chapter.

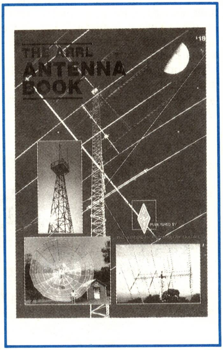
The book is quite readable, if you can handle American spelling (gage for gauge, liter and so on), and a lot can be learnt from the book even if you are a bit wobbly on Laplace transforms. Many books on control theory are either patronisingly simple, or totally unapproachable, but this one seems to bridge the two levels, and should prove popular for those studying this subject. (P.P.)

Antenna manual

THE ARRL ANTENNA BOOK, 15th Edition, edited by Gerald Hall, K1TD. Published by the American Radio Relay League, 1988. Soft covers, 278 x 210mm. ISBN 0-87259-206-5. Recommended retail price $39.95.

Another quite large book on antennas, but unlike the monster I reviewed here last month this one has its emphasis far more on practice than theory. As you'd expect, coming from the ARRL, it's very much a down-to-earth manual for the practising radio amateur – or anyone else with a strong interest in the 'doing it' side.

That doesn't mean that there's no theory. Far from it, in fact. There's quite a lot, and explained with the clarity and accuracy we've come to expect from ARRL publications over the years. This should also make the book of value to students doing communications engineering courses at universities and colleges, and even justify its place on the reference shelf of professional antenna designers.



The first ARRL Antenna Book was produced in 1939, and since then the various editions have sold over 720,000 copies – an impressive record. This latest 15th edition has been updated and enlarged, while the text has been fully re-edited. There are now 30 chapters, and although I can't give you a total page count (since the pages are not numbered consecutively) the overall thickness of the book is 35mm. It's a solid volume.

Needless to say, there is a heavy emphasis on the design, construction and testing of antennas for the various amateur radio bands – from HF right up to the microwave bands used for satellite communications. But there's also a lot of quite general information as well, which will be of interest and value to almost anyone involved with antennas, transmission lines and propagation. For example chapter 2 deals with basic antenna theory, chapter 23 with propagation, chapter 24 with transmission lines, chapter 27 with measurements and chapter 28 with using the Smith Chart – all highly readable material. And one of the things I particularly like about the book is that most chapters end with a very worthwhile list of references for further reading.

An excellent reference book for almost anyone working with antennas, but especially radio amateurs. The review copy came from Dick Smith Electronics, which has it available in all stores. (J.R.)

Experiment with an optical-fibre link:

Opto Link AM-1

Here's a simple and easy to build optical fibre transmitter-receiver project which will let you experiment with this exciting new communications technology at low cost. It uses amplitude modulation to transmit audio signals along a 1mm monofilament fibre optic cable up to 15m long.

by COLIN MITCHELL

The Opto Link project described in this article is designed to show how an optical fibre can be used to provide a secure communications link, free from the risk that the information can be intercepted. It has been designed as an easy and practical introduction to the world of optical communications, which is without doubt becoming the future medium for voice, TV and data transfer.

The project uses an amplitude modulated light beam to transmit an audio signal in one direction along a 1mm monofilament glass fibre optic cable. Good frequency response is achieved by carefully selecting the bias components of both the transmitter and receiver.

The basic Opto Link AM-1 project has been designed by Universal Fibre Optics Corporation (UFO Research), with the co-operation of *Talking Electronics* magazine. Complete kits for the project, including batteries, are available for $47.95 from the suppliers listed at the end of the article.

Basically the project is capable of transmitting in one direction over a distance of 15 metres or more. The kit comes with 5 metres of high-performance TSU-1.00/1 fibre, but you can replace it with a longer 15m length if you wish.

Two kits may be used to establish a two-way communications link. If desired these may be purchased together with a 5 metre length of figure-8 or 'duplex' cable (TSU-1.00/2), for a special price of $90.

Background

UFO (Universal Fibre Optic) Research was the first fibre optic company in Australia and their products go back to the fibre optic 'decor lamp' days, when fibres by the handful were allowed to fall gracefully in a bunch to produce a myriad of point-sources of light. These lamps were very popular and quite startling, but they did not use the fibres to the full potential.

The potential of a single optical fibre is quite astounding. It is capable of handling up to 200,000 telephone conversations and/or a number of television transmissions at the same time! There's no doubt that it is the medium of the future and will eventually overtake two-wire and coaxial transmissions.

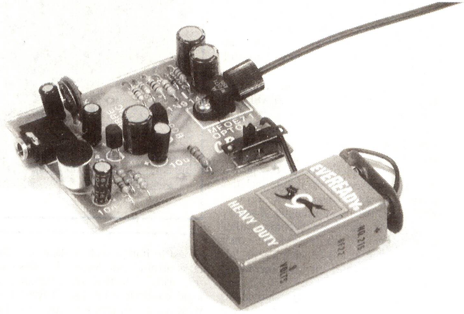
This opto link project utilises only the fraction of the cables' capability, but provides an ideal demonstration for exploring the possibilities of fibre transmission. It consists of a transmitter and receiver, each mounted on a small PC board 55mm x 60mm and joined via an optical fibre cable 5m (or 15m) long. The whole project can be completed in an evening and you end up with a one-way speech link for under $50.00 – the first time this has been possible, we believe.

The project is relatively easy to put together. However it is important to read the instructions fully as a couple of traps exist, especially when preparing the cable.

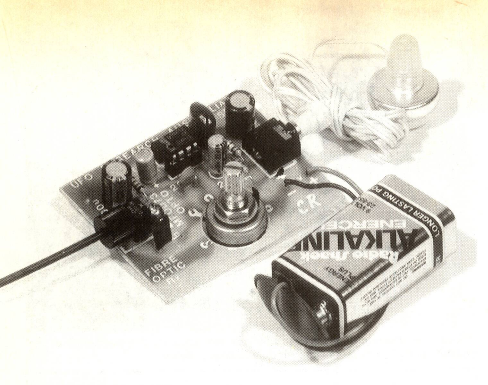
The printed circuit boards can be placed in individual cases, behind a console or used in a skeleton situation for demonstration purposes. The main value of this project is to familiarise yourself with the method of transmitting via an optic cable.

Crucial parts

For most people, the new and interesting pair of components in this project are the devices that clamp onto the ends



The transmitter module, which includes an on-board electret microphone – but also a socket which allows you to use an external mic instead.



The receiver module, which can be used to drive either headphones or a small speaker. The opto detector is at lower left.

of the cable. These are made by Motorola and consist of an infra-red emitter MFOE71 and a photo-Darlington receiver MFOD73.

All of these devices are spectrally matched to emit and receive at the peak transmission wavelength of optical fibre, which is 1300 nanometres (1nm is one thousand-millionth of a metre). Each device is complete with fibre alignment guide tube, cable locking nut and collet and a PC mounting bracket.

The plastic monofilament fibre optic cable supplied with the kits is TSH-1.00/1, but if an increased range is required, a high performance type TSU-1.00/1 is available.

Since the cable does not conduct electricity, two separate power supplies are required and this means the project does not compete with equivalent intercoms and introduces a completely different approach to communications. The advantages of optical communications will become evident when you construct the project and perform some of the experiments.

How it works

The circuit of the transmitter module consists of two separate transistor stages, the first being a preamplifier and the second a power amplifier.

The signal is picked up by an electret microphone and this consists internally of a field-effect transistor (FET), in which the gate (equivalent to the base of a normal transistor) is connected to a diaphragm of very thin plastic film that looks very much like metallised mylar, mounted a short distance in front of an earthed metal plate. The plastic film is electrically charged during manufacture and remains charged for the life of the microphone. Together with the earthed plate it forms what is basically a permanently charged capacitor – hence the name 'electret', because in a way it is like an electrical version of a permanent magnet.

When the sound waves hit the diaphragm, it vibrates and this makes the capacitance between it and the earthed plate change. Since the electrical charge is fixed, the voltage therefore changes at the FET's gate. The FET amplifies the effect and the result appears on the output lead.

Since the microphone includes an active component (the FET), it must be fed with a current and this is supplied via the 2.2k resistor. The 680 ohm resistor and 10uF electrolytic form a decoupling network to separate the highly-sensitive front end from the remainder of the circuit, preventing instability.

The output of the electret microphone passes to the external mic socket and is switched out of circuit when an external microphone is used.

From there the signal passes through a 10uF blocking capacitor, so that only the AC component of the signal is fed to the 100k pot. The pot serves as a volume control and can be adjusted to suit the signal. The output of the pot connects to another 10uF electrolytic and this blocks the DC on the base of transistor Q1 from entering the pot. If DC were to enter the pot, the bias on Q1 would be upset, especially when the wiper was near earth.

The base of Q1 is biased via the 82k and 10k resistors, with the 330 ohm emitter resistor providing negative feedback to stabilise its DC operating conditions. The 3.9k resistor forms the collector load. These resistors all set the DC bias conditions and the actual 'set point' requires mathematics to derive.

It is sufficient to say that the voltage on the base will be very nearly equal to 9V divided down by the ratio of 82k to 10k and this means it is about 1V. This voltage will turn the transistor on, and 0.65V will be dropped across the base-emitter junction. This leaves about 0.35V for the voltage across the 330 ohm emitter resistor, setting the transistor current to about 1 milliamp.

The 100 ohm resistor and 100uF electrolytic form a partial emitter bypass arrangement, so that the gain of the transistor is maintained when it is passing AC signals. There is still some emitter degeneration (negative feedback), which also reduces stage distortion.

The signal appears at the collector of Q1 and is fed into the base of the second stage Q2 via a 10uF electrolytic. This provides stage separation as the DC levels at its ends are different.

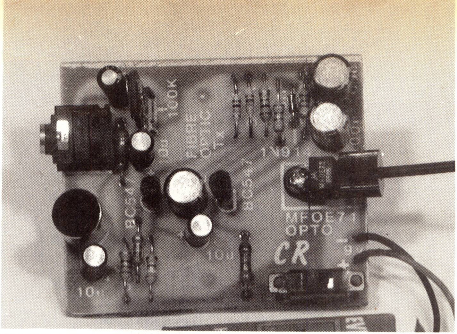
• The output stage is another common-emitter arrangement, with the 560 ohm and 470 ohm resistors (plus the series signal diode) setting the base bias and the 1.5k emitter resistor setting the collector-emitter current. In this case the collector load is formed by the transmitting diode MFOE71.

The resistor values for the output stage have been chosen so that the quiescent current through the transistor is less than 20mA. This is the current when no signal is being processed, and is sufficient to just illuminate the LED so that it will transmit down the cable.

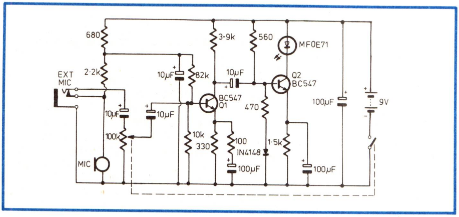
Any current higher than this would be wasteful, while if the current were to be reduced, we would get clipping (distortion).

The 100uF emitter bypass electrolytic provides AC gain for the stage by successfully keeping the emitter voltage near the quiescent value, when a signal is applied to the base. This allows the base-emitter voltage to fluctuate, and thus the current through Q2 and the transmitting LED. The LED brightness will therefore alter according to the amplitude of the signal.

The diode in the base circuit has been included to give the stage a small amount of constant current capability



Above is a close-up of the transmitter module, showing the placement of the components. The circuit of the module is shown below.



and also thermal stability.

The 100uF across the battery provides power supply decoupling and is very important when the battery is starting to go 'flat'.

Depending on whether the supply is a normal set of dry cells or alkaline cells, the internal impedance of the battery will vary greatly from 'new' to 'old'. If uncorrected this change in internal impedance can alter the operation of the circuit, causing a number of annoying faults. These include the circuit going into self-oscillation and distorting.

The 100uF electrolytic prevents these problems by maintaining a low impedance supply. It also provides a 'reservoir' of charge, able to deliver bursts of current during peak demand so that distortion is prevented.

A new battery is recommended to get the best out of the circuit and if you want to use the project for extended periods of time, a set of six 'D' cells is the cheapest way to get portable power.

Moving now to the circuit of the receiver module, this is basically an LM386 op-amp driven by the optical receiver device, and in turn able to drive a speaker.

The MFOD73 optical receiver uses a super-alpha or 'Darlington' transistor configuration, and is sensitive to light in the infra-red range.

Light falling on the base junction of the input transistor within the unit lowers the collector-emitter resistance. This provides forward bias for the lower transistor and thus the effect is amplified about 60 times, with the result appearing at the output of the device.

The 5.6k resistor is a load, and the voltage at the 10nF will thus vary according to the signal being received from the optic fibre. This voltage variation will pass through the capacitor and appears across the 5k potentiometer. The moving arm of the pot will pick off a percentage of the voltage and can be adjusted to give the circuit a 'sensitivity' range.

The pot will attenuate the signal from the infra red receiver, and the low resistance of the pot has been selected for two reasons. Firstly it prevents any voltage appearing on the non-inverting input and secondly it attenuates the input signal as we require only about 400mV for the chip to produce maximum output.

Both the positive and negative excursions of the input signal are passed to the non-inverting input of the LM386 op-amp, where they are amplified.

When the inputs of an LM386 are ground referenced, as they are in our arrangement, the output is automatically biased to one half the supply voltage. The non-inverting input is connected to ground via the 5k pot and isolated from any DC voltage via a 10nF capacitor. The inverting input is connected directly to ground and this means both inputs see zero voltage when the amplifier is in the quiescent state.

The gain of the amplifier is set at 20 by the components within the chip but the addition of a capacitor between pins 1 and 8 will increase the gain. When a 10uF electrolytic is added between these pins (as we have here), the gain rises to 200.

The 22uF electrolytic on pin 7 is a bypass capacitor and prevents power supply fluctuations affecting the signal.

The 100nF capacitor and 10 ohm resistor across the output are compensation components and are needed for the output stage (within the chip). They form a load of 10 ohms at high frequencies, as the speaker is a poor load at this frequency.

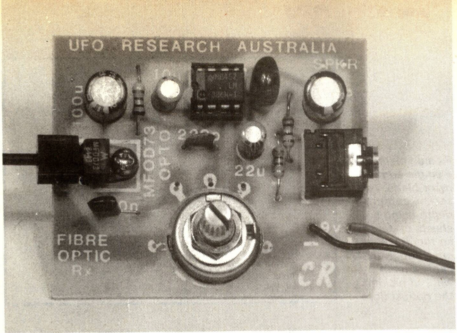
The 220uF electrolytic provides a low impedance path for the speaker circuit and prevents the DC voltage on the output of the chip from entering the speaker. If it were to get to the voice coil, the cone would shift or 'offset' from its mid-position and distortion would result. The electrolytic must be a high value to pass the low frequencies.

The 100uF across the battery is again to keep the impedance of the supply low and improves the performance of the circuit, especially when the battery is getting low.

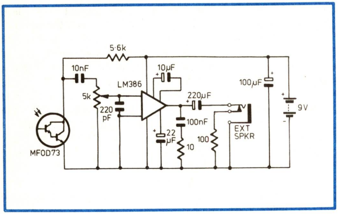
Before you start

Before assembling either the transmitter or receiver, it is important to allow yourself a few night's for construction and experimentation. Clear the bench, clean the soldering iron and collect all the necessary tools.

We will be starting with the receiver and you will need a clean area on which all the parts can be laid. Make sure you can identify the resistors by their colour



And here is the receiver module (above), again showing the component placement. Be careful with the polarised parts!



Left: the circuit of the receiver module. Like the transmitter it runs from a 9V battery.

code.

We suggest making the receiver section first as it can be tested using daylight or an incandescent lamp. Then you can build the transmitter section.

Firstly you should make sure that all the holes have been drilled on the PC board, including the larger holes, as it is very difficult to drill a hole when some of the parts have been fitted.

Check the trackwork for poor etching and bridges between tracks, as these could cause a lot of worry when you are fault-finding.

Also check the overlay (the printing on the top of the board) and make sure it shows where all the parts are placed. There are a couple of places where you will have to refer to the assembly instructions for the component values. These are the 10nF capacitor on the receiver board and 1.5k resistor on the transmitter board.

When you are happy you know what to do, you can start. Go carefully, because if you do, the project is sure to work – it has been tested via many prototypes. The only faults are likely to be careless mistakes on your part, so please follow the instructions.

Assembling the receiver

Before mounting any of the parts on the board it is important to make sure all the holes have been drilled, as mentioned above, and see that the pot fits through the large hole. The body of the pot must fit so that the tabs touch the PC board. If the hole is too small, use a tapered reamer to make it larger.

Start by fitting the three resistors, making sure they are pressed against the board before soldering.

Next fit the IC socket. One end has a cut-out to align with the dot on the board. This will enable you to identify pin 1 of the chip. The two metallised polyester 'greencaps' are next, followed by the 220pF ceramic, and then the four electrolytics.

The electrolytics must be mounted with the positive and negative leads down the correct holes, as these capacitors are polarized and will not work if they are around the wrong way. The negative lead of the electrolytic is marked on the side of the component by negative signs. The positive lead is identified on the board, and is usually longer on electrolytic capacitors, so don't make a mistake.

The 3.5mm socket is a stereo type, but only mono is received in our arrangement. You can use either a mono or stereo plug and either will work. Before mounting the socket, cut off the plastic lugs to allow the socket to fit against the board so that the pins can be soldered – there are 5 of them.

The switch-pot is mounted so that the lugs on the pot can be soldered directly to the lands on the board.

Finally the infra-red receiver and battery snap are added. Two plastic spigots on the receiver unit (MFOD73) fit down locating holes on the PC board. Screw the self-tapping mounting screw securely home, and then solder the two leads. Then fit the LM386 op-amp chip into its socket and the receiver is ready for testing.

Testing the receiver

Before connecting the battery, check all the components to make sure that:

1. The battery snap leads are red to (+) and black to (-).
2. The electrolytic capacitors are the right way around.
3. The resistors are in their correct positions on the board.
4. The cathode of the diode (black band) matches the overlay.
5. The IC is facing the correct way and all pins are pushed into the socket.

After you are satisfied that you have checked everything, connect your walkman headphones into the 3.5mm socket or wire a speaker directly to the board. One lead goes to the negative of the 220uF electrolytic and the other end goes to earth.

Make sure the switch is in the off position (fully anti-clockwise) and connect a *new* 9V battery to the snap. Then while the on-off switch is in the OFF position, measure the current consumption of the circuit by connecting across the switch contacts (these are the two large lugs on the switch-pot).

Set your multimeter to the 100mA range (or nearest setting) and make sure it reads up-scale.

The quiescent current should be less than 20mA and if this is the case, you can turn the project ON and listen.

By turning the receiving diode towards daylight and adjusting the pot, you should hear a background noise very similar to a radio off the station. Pointing the diode to an incandescent lamp should produce a 100Hz 'mains hum', while pointing directly to the sun will produce a different noise.

If this all happens, it indicates that the amplifier is working and you are ready to make the transmitter and connect the two together. (But if you don't get these results, you will need to read the 'If it doesn't work' section, at the end)

Assembling the transmitter

Before mounting the parts on the transmitter PCB it is necessary for you to decide if you will be using the inbuilt microphone or an external mic. This is because the mic can be fitted to the board, mounted on stand-offs (or short leads) or connected via a 3.5mm jack to the external mic socket.

Also the sensitivity control (volume control) can be either a pre-set pot mounted on the board, or a larger volume control mounted on the front panel of a case etc. This also applies to the switch.

We will describe construction with all components mounted on the PC board to make everything self-contained.

Start construction by inserting all the resistors and the biasing diode. These components are kept close to the board and should be fitted first, as it is too difficult when other parts are in position.

Next mount the taller components such as the electrolytic capacitors and transistors. The transistor leads are identified as collector, base, emitter, viewed from below and moving from left to right when the flat of the transistor is across the top. This is important as the transistor must be inserted around the correct way, otherwise it may be damaged.

The electrolytics are next and the positive lead is identified on the board, while the negative lead is identified on the component. Don't get them around the wrong way as they will not work in reverse.

Next mount the pre-set pot. This can be either a screwdriver adjustable type or one intended for a knob.

Mount the ON-OFF slide switch. Press it hard against the board, so that it can be soldered to the tracks. Cut the five plastic lugs off the 3.5mm socket so that it fits flush onto the PC board.

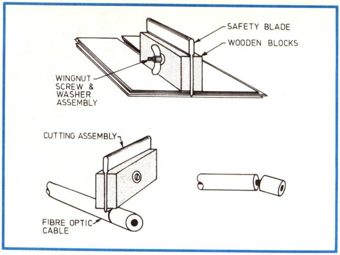
The socket is stereo to allow both mono and stereo jacks to be inserted. The electret microphone must be fitted so that the earth lead (the case of the microphone) goes to the negative rail. If there is another lead close to this (on the back of the microphone) it must also be taken to earth too.

The other lead on the mic is the 'active' and is taken to the other hole on the board, as shown in the diagram.

Connect a 9V battery snap and the board is ready for fitting the infra-red transmitting diode MFOE71.

You will notice 5 holes are available on the board for this. Two of the holes are locating holes for two spigots on the base of the unit. This allows the diode to fit firmly against the board and prevents it moving when inserting or removing the fibre optic cable. Two of the other holes are for the leads and one is to take a self-tapping screw. Screw it securely into the MFOE71 before soldering.

This completes the assembly. Look over the board and make sure nothing has been left unsoldered and that all parts are in their correct places.



Fit side clamps to a single-edge razor blade, and set the cutting depth using 5 sheets of paper so that it will just cut through the cable sheath without nicking the optical fibre.

Preparing the cable

Before the cable is inserted into the ends of the transmitting or receiving units, the outer sheath must be removed for a distance of 3mm. This is because the guide hole is stepped and the sheath will prevent the fibre touching the lens of the LED or photo transistor.

The cable in the kit is probably already prepared, however if you shorten the cable, or wish to use a longer cable, it will have to be prepared. If the fibre does not touch the lens, the transmitting range will be severely limited.

To remove the outer sheath, use a sharp knife, making sure it does not penetrate deep enough to touch the active surface of the fibre. If you cut the surface of the cladding, the transmission level will be severely reduced, so be very careful.

A simple jig to create a neat result can be made from a single-edged safety blade and two pieces of wood or plastic. The accompanying diagram shows how to clamp the blade between the wood or plastic with a bolt and wing-nut. The slot in the blade allows movement of the cutting edge and this is set so that it protrudes a distance equal to the thickness of the fibre's outer sheath. The covering can then be stripped off when the cable is rotated and pulled gently.

The cable may have to be bent slightly to allow the unwanted sheath to be removed. It may take a few minutes to make the jig, but it will be very handy when you need to prepare cable ends.

If it doesn't work

When you hook everything together and turn both modules on, you should be greeted by a working audio link. Sounds picked up by the transmitter unit's microphone should be clearly heard in the speaker or earphones connected to the receiver.

If this doesn't happen, or if the receiver didn't give the expected results when you first tried it out, the first thing to do is check the receiver module for mistakes in soldering and the other stages of assembly.

Try measuring the receiver module's current drain. If the current consumption is 20mA or less, you can be fairly sure the chip is operating.

Measure the voltage on the output pin (pin 5). It should be about 4.5V. Turn the sensitivity control up and connect a 10k resistor between the positive rail and pin 3. Make and break contact a number of times and you should hear loud clicks in the speaker.

If these clicks are not heard, the fault may lie in an open circuit between the speaker and the output of the chip. Try connecting the speaker directly between the negative lead of the 220uF and earth.

If the loud clicks are heard, the next section to test is the infra-red receiver. Place a voltmeter across the optical receiver and block out any light by covering the hole.

The voltage should be about 8-9V. If it is lower than this, the fault lies in the sensor itself or its immediate circuit (we are assuming the battery voltage is 9V). This could mean any part between the MFOD73 and the first transistor; it could be the 10nF greencap, or a solder bridge under the board.

Allow light to pass down the hole onto the detector. The voltage should fall and how far it falls will depend on the amount of light being detected.

One possibility is an incorrect value resistor for the sensor's load. If you have used a 560 ohm or 56 ohm resistor instead of the 5.6k, the voltage will not fall as much and may even damage the sensor device.

One fault not to be overlooked is the insertion of the IC. Make sure all the pins of the chip go into the IC socket and the pins of the socket go through the holes in the board. If a pin bends over and doesn't go though the board, it can take hours to trace!

Kits for this project are available from:

U.F.O. Research,
564 Glenhuntly Rd.,
Elsternwick, Vic. 3185.
(03) 523 5535

and:

Talking Electronics,
35 Rosewarne Ave.,
Cheltenham, Vic. 3192.
(03) 584 2386

Kit Price: $47.95 each plus $3.50 packing and post. Phone orders welcome. Mail-orders dispatched same day. Cheques/Cash/Money Orders and credit cards accepted. Callers welcome at either address.

If you want 15m of fibre optic cable in place of 5m (in the kit), add $27.00. If you want an extra 15m of fibre optic cable, add $38.00. Cable can be purchased by the metre @ $2.31 for TSH-1.00/1 or $2.44 per metre for high performance TSU-1.00/1.

A pair of light-weight headphones is available for $7.50.

If you want a two-way communication link, you will need to buy two complete 'Opto Link AM-1' kits. A special price on this is $90.00 including 5 metres of high grade TSU-1.00/2 duplex fibre optic (figure 8) cable. Order kit No. 2AM-1/duplex.

Words of caution

An infra-red emitting diode and detector set can be purchased from some of the larger chains of electronics shops as MFOE71 and MFOD72. The MFOD72 is a single phototransistor, and is not nearly as sensitive as the MFOD73 (which is a Darlington device) and will not give the same performance as described in our notes.

Secondly, any emitting or detecting units not bought via a UFO kit must be made light-tight by filling the underside of the unit with opaque material such as black silicon sealant, or even dark plasticine, to prevent light entering and creating background noise. This is important and must be done before soldering the unit to the board.

Transmitter faultfinding

It will be very difficult to fault-find the transmitter section by itself and you must first have the receiver section assembled and working correctly.

We will suppose you have done this, and now need to check the transmitter section. Firstly test it for current consumption by connecting a milli-ammeter across the slide switch when it is in the OFF position. The current should not be above 25mA and if it is in the range 15 to 25mA, you can assume the output stage is working. You may see a faint glow coming from the infra-red LED to prove this.

Connect the optical fibre to both units and switch them on. If the microphone is in close proximity to the speaker, you will hear a loud whistle. If this is not heard, the problem will probably lie in the transmitter section.

Further tests on the output stage are difficult to carry out and you should proceed to test the other two stages – the preamp and microphone stage.

The preamp stage is just at the point of being turned ON and the voltage on the collector should be about 5.5V. The emitter voltage should be 0.25V and the base about 0.7V. Use a high sensitivity voltmeter or multimeter to measure these.

The next section to test is the microphone stage. It is an active device and has a FET (field-effect transistor) inside the housing. The voltage across the microphone will be about 7.5 to 8 volts and any wide variation from this will indicate the mic circuit may be open or

PARTS LIST

Receiver module

Resistors

1 10 ohm (brown-black-black)
1 100 ohm (brown-black-brown)
1 5.6k (green-blue-red)
1 10k switch pot

Capacitors

1 220pF ceramic
1 10nF metallised polyester
1 100nF metallised polyester
1 10uF 16VW PC electrolytic
1 22uF 16VW PC electrolytic
1 100uF 16VW PC electrolytic
1 220uF 16VW PC electrolytic

Semiconductors

1 LM 386 IC
1 MFOD73 IR receiver

Miscellaneous

1 3.5mm stereo socket
1 9V battery snap
1 9V battery
1 self-tapping screw
1 AM-1 receiver PC board 'Fibre Optic Rx.'

Transmitter module

Resistors

1 100 ohms (brown-black-brown)
1 330 ohms (orange-orange-brown)
1 470 ohms (yellow-purple-brown)
1 560 ohms (green-blue-brown)
1 680 ohms (blue-grey-brown)
1 1.5k (brown-green-red)
1 2.2k (red-red-red)
1 3.9k (orange-white-red)
1 10k (brown-black-orange)
1 82k (grey-red-orange)
1 100k mini trimpot

Capacitors

4 10uF 16VW PC electrolytics
3 100uF 16VW PC electrolytics

Semiconductors

1 1N4148 diode
2 BC547 transistors
1 MFOE71 IR transmitter

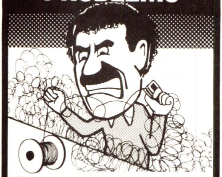
Miscellaneous

1 electret mic insert
1 9V battery snap
1 9V battery
1 self-tapping screw
1 AM-1 transmitter PC board 'Fibre Optic Tx.'
1 5m fibre-optic cable with prepared ends

ELECTRONIC BROKERS AUSTRALASIA
TEST EQUIPMENT
Australia's largest range of secondhand:
Hewlett Packard
Tektronix
Marconi
Solartron
Boontoon
BWD
Bruel & Kjaer
Oscilloscopes, sig gens, spectrum analysers, multi meters. Wide range of valves, coaxial connectors and test accessories. Repairs and service to all makes and models.
All types of equipment bought and sold.
WE TRADE ALSO!
Calibration facilities available.
Screened room and Vibration measurement systems for hire.
Communication equipment, Scanners, Mobile Phones and accessories, Ham gear.

Cnr. Barry St. and Brunsdon St.
BAYSWATER 3153 VIC.
(enter from Brunsdon St.)
TELEPHONE (03) 729 0455
Mobile Phone 018 312 203

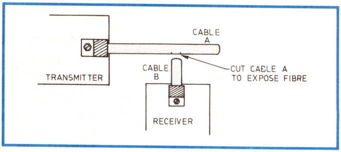
DON'T GET WOUND UP OVER YOUR WINDING PROBLEMS



We custom design and manufacture in volume, transformers and coils for any application.

Selectronic Components PTY. LTD.
25 Holloway Drive, Bayswater,
Vic., 3153. Telephone: (03) 762 4822.

Opto Link AM-1



How to set up the two modules with short lengths of optical fibre, for experiment 4 (below).

shorted. The next item to test is the 100k sensitivity control. Make sure it is turned to mid-position – this prevents a mistake such as turning it down fully while thinking it is turned UP fully!

Another clever way of testing the amplifier is to connect a speaker directly across the transmitting LED.

You will not get a feed-back whistle but by blowing into the microphone, or tapping it with a finger or screw-driver, the tap will be heard faintly in the speaker.

These tests should direct you to the area at fault and by now you should have both ends working perfectly. The quality of audio we achieved from our prototype was most impressive and the optical link can be put to quite a number of uses.

At this stage it is mainly confined to demonstration uses, as the need for two power supplies for a one-way communication is a bit limiting.

Experiments

As a finale, we have prepared five experiments for the Opto Link, to show you how you can turn your model into a very effective science project. Here they are:

1. One of the first experiments you can carry out is to see the importance of good end terminations.

The cable must fit into the receiver and transmitter units so that outside light is blocked out and the cable is in alignment with the transmitting and receiving 'heads'. To demonstrate this, pull the cable out slightly from one unit and see how the transmission suffers. Then insert the cable gradually again and determine the optimum position.

2. Stretch the fibre optic cable out fully and keep it as straight as possible. Determine the quality of transmission. Then coil the cable around your hand and determine if the quality of transmission is reduced.

3. For this experiment you will need a short length of cable (about 10cm) between the two units. You can cut this from the main length and prepare the ends as already described. Then connect the cable and switch the link ON.

The object of this experiment is to cut the sheath with a blade and begin to damage the cable by exposing it to the light, gradually cutting into the centre core to see what effect it has.

Determine the effect of scraping the core and cutting around it with a blade so that it becomes permanently damaged. Determine how much damage is required before the link drops out completely.

4. In this experiment you will aim to 'intercept' the transmission of cable 'A' with receiver 'B' (see sketch).

We claim it is impossible to pick off sufficient signal from cable 'A' to intercept the transmission. Your aim will be to see if you can do this.

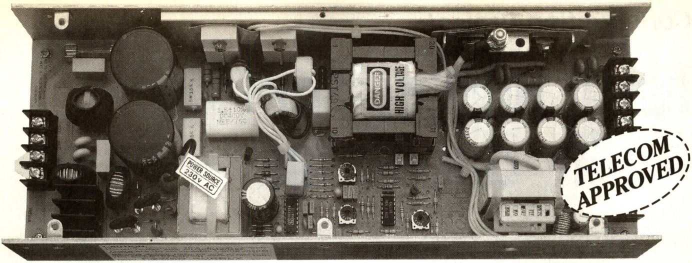
Connect a short length of fibre-optic cable to the transmitter module and leave the other end unconnected. Connect *another* short length of cable to the receiver module, and attempt to tap into the transmitter cable by cutting the cladding with a blade and scraping the surface of the fibre to pick up some of the signal.

In a full-scale set-up, the data link will be in constant communication and if it is tampered with, an alarm will sound.

5. Fibre optics is ideally suited to detecting the angular movement of a slotted disc, etc.

Fit a short length of cable to the receiver module and place a slotted disc in front of the fibre. As the disc rotates, a clicking sound will be heard in the headphones.

You can also use the receiver and about 30cm of fibre to detect holes and cracks in a light-tight box. You can feed a longer cable into a pipe or box to locate cracks etc. This opens up a whole new range of experiments for a probe as fine as the end of the cable.



Shown with cover removed

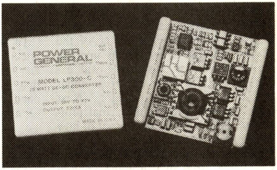
They've already met tougher specifications than yours. VDE, UL, FCC and CSA.

Shown above is model UN1300-48ABC. This is a 300W single output supply with 48V @ 6.5A from a 90-132V/180-264V, 47-440Hz AC input. Full overvoltage, overcurrent, short circuit and thermal protection is built in. It is approved by Telecom (No. RA87/112)

Our 15-300 watt power supplies meet every important safety and performance standard in the world, including VDE, UL, FCC and CSA.

And some have TELECOM Australia approval, one of the most stringent standards in the world. Surprisingly, the cost of all this quality and performance is very low.

Most needs can be met from our large range of standard models. If you have special needs, we can meet them quickly and easily by custom designing to your specification.



*Shown above LP Series DC/DC Converters. Features: • 0.375" max. ht. • 7.7 watts/cub. in. • isolated triple outlets • 25 watt output power • 500kHz MOSFET switching • Surface Mount Technology • high MTBF 300,000 hours • **5 year warranty** • internal π input filter is standard to minimise reflected ripple on input buslines • continuous 6-sided shielding virtually eliminates radiated emissions*

If you need DC/DC converters, we can help you there too, with a range of low profile units from 1 to 100 watt ... the compact answer for just about any design need.

Whatever your requirements in power supplies or converters, talk to our engineers. They'll be glad to help you find the simplest, surest, most cost-effective answer.

SYDNEY:
Centrecourt
25-27 Paul Street Nth
North Ryde 2113
Tel: (02) 888 8777
Fax: (02) 887 1283

MELBOURNE:
1064 Centre Road
Oakleigh South 3167
Tel: (03) 575 0222
Fax: (03) 579 0622

PERTH:
106 Howe Street
Osborne Park 6017
Tel: (09) 242 2000
Fax: (09) 242 2150

PARAMETERS PTY LTD
PERFECTION IN MEASUREMENT

JBA 203

Construction Project:

New low distortion Audio Oscillator – 1

Next month an unusual design for a low distortion oscillator will be presented. This article is by way of an introduction, and gives the background to the project. The design uses high performance op amps in a phase shift oscillator combined with a clever third harmonic cancelling network, and has resulted in a circuit that is far simpler and cheaper than current 'high tech' designs.

by PHIL ALLISON

A low distortion oscillator that is simple and cheap seems a contradiction in terms. And judging from some of the current designs, it also seems impossible. However, as this article will explain, there is 'another way' to go about designing such an oscillator. Next month we will present the actual project, which will be the final proof of how simple things can really be.

The circuit and concepts presented here derive from an article appearing in the February 1982 issue of *Wireless World*, written by Mr Roger Rosens. Astute readers may even recall that the 'Circuit and Design Ideas' section in *EA*'s May 1986 issue contained a design based on Mr Rosens' circuit.

The traditional Wien bridge audio oscillator has served very well for many years, surviving the transition from valve technology to transistors and more recently the integrated circuit era. Most of these designs followed the same approach, using the Wien bridge network around a stabilised amplifier. This configuration was popular as it lent itself to variable frequency operation.

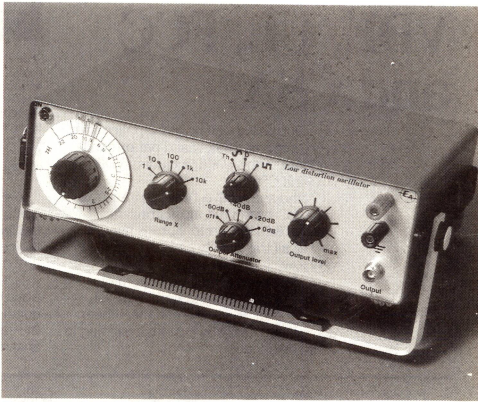
Stabilising methods

The simplest and most commonly used method of stabilising the output amplitude of a Wien bridge oscillator is to place a thermistor in the negative feedback path, as shown in Fig.1. However the venerable NTC glass bead thermistor has always set severe performance limits to any oscillator circuit. There are two main problems encountered with thermistors used in oscillators:

The first is that thermistors are nonlinear, meaning they can distort the signal applied to them by the simple fact that they change in resistance with applied voltage. Because of the thermal inertia of a mass of material suspended in a vacuum, the resistance changes relatively slowly, therefore not affecting high frequencies.

However for frequencies below 100Hz the thermistor is the predominant source of distortion. At low frequencies the thermistor is able to heat and cool, slightly, twice during the period of one cycle. This changes the gain of the sustaining amplifier and causes the output sinewave to undergo positive and negative peak compression – and significant third harmonic distortion.

It should be noted that any distortion of a sinewave that is symmetrical about the centre line always generates *odd order* harmonics: that is, the third, fifth, seventh and so on. In most cases where



Here's what the final oscillator looks like. Further construction details will be presented next month.

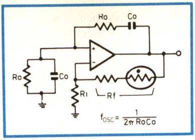
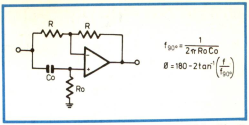


Fig.1 The basic Wien bridge oscillator configuration.


R
R
Co
Ro
$f_{90°} = \frac{1}{2\pi R_o C_o}$
$Ø = 180 - 2\tan^{-1}\left(\frac{f}{f_{90°}}\right)$

Basic all-pass filter stage as used in Fig.2 for a complete oscillator.

Fig.2 (right). Complete oscillator using two all-pass filter networks.

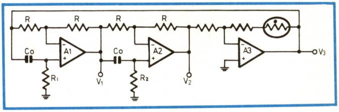
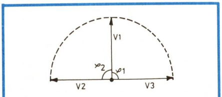


Fig.3 (below). Fundamental frequency output signal phase relationships



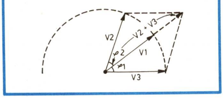


Fig.4 (left). Phase relationships of the third harmonic signals from Fig.2. Angles 1 and 2 both equal 37°.

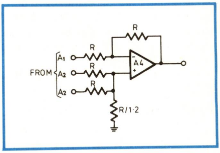


Fig.5 (above). Summing the signals to cancel the harmonics.

distortion is slight, the third harmonic predominates and this is very much the case with thermistors.

The fact that distortion in thermistors is almost entirely third harmonic is used in the new design to eliminate such distortion from the output of the oscillator.

Also, thermistors have a slow reaction to changes in applied voltage. This reduces distortion at medium and high frequencies, but results in an oscillator which has an unstable output level when the frequency or range is changed. This instability is commonly known as 'bounce'. Anyone who has used a Wien bridge oscillator will be familiar with having to wait a few seconds for the output level to stabilise before taking a reading on a meter.

Low distortion designs suffer most from 'bounce' since the effective 'Q' of the circuit is higher. Some people find bounce so annoying that they buy or build function generators where the sine wave output is derived by 'shaping' a triangular wave. Because no thermistor is used, the output level is rock steady but the sinewave output is usually poor, and distortion is easily visible on a scope screen as well as being highly audible.

Some designers have solved the thermistor problem by doing away with the culprit, substituting a FET as the gain control element in the oscillator. This requires special design of the oscillator to minimise voltage across the FET, as well as elaborate sample and hold circuitry to bias the FET with a pure DC voltage proportional to the output of the oscillator.

These designs are complex and can be tricky to set up and work on. In fact some might comment that the cure is worse than the disease. See *EA* December 1986 for an example of this approach.

Another way

If somehow the third harmonic can be removed from the output of a thermistor-stabilised oscillator, then its distortion factor would be significantly reduced. If the tendency to bounce could also be reduced or eliminated without increasing cost or complexity, then we would have a wonderful design.

The new design to be described achieves both these goals with a remarkably simple, low cost circuit.

The oscillator circuit shown in Fig.2 employs two identical phase shift networks, known as *all pass filters*. These filters rotate the phase of an input signal over the range from 0 to 180° without altering the amplitude. The centre is at 90° and two cascaded together will provide the necessary phase reversal at a particular frequency (fo) to make the circuit oscillate. The thermistor in the local feedback path around gain stage A3 stabilises the waveform at a particular voltage level, depending on the amplifier circuit configuration and the voltage of the power supply.

Already there are several advantages compared to a Wien bridge oscillator. The two resistors R1 and R2 (which are varied to change frequency) need not be the same value for reliable oscillation. There will *always* be one frequency where the combined phase shift is 180°, and since the amplitude is unaffected, no change of level will occur.

So if a dual gang pot is used for R1 and R2, the matching between halves is not important to normal operation. A by-product of this is that bounce is much reduced when the pot is varied, since the amplitude of the signal fed to the thermistor is relatively constant.

The second thing to note is that the oscillator has three possible outputs: that from A3 at 0°, from A1 shifted 90° and from A2 shifted 180° – compared to A3. At least these are the phase angles that apply for the fundamental.

The trick is that any third harmonic generated in the thermistor is also shifted in a similar fashion, but this time by around 37° through A1 and a further 37° by A2, giving a total of 74° at the output of A2.

Therefore the outputs of A2 and A3 are always out of phase as far as the fundamental is concerned, so the fundamental components from these outputs will cancel if they are summed – as shown in the vector diagram of Fig.3. The harmonics will however add, being only 74° apart in phase (in the case of the third harmonic). And they will add to produce a resultant which has a phase angle half that of A2. That is, 37°, the same as A1 (Fig.4).

If this resultant is suitably scaled and *subtracted* from the output of A1, then the third harmonic will theoretically disappear. The necessary scaling, addition and subtraction is done by A4 (see Fig.5) and indeed the third harmonic is very much reduced. Component tolerances, particularly matching of the dual gang pot prevent complete elimination of the distortion, however. This is because if the two pot sections are not exactly matched, the phase shifts of A1 and A2 won't be exactly equal and the harmonic components won't completely cancel out.

Putting all this in a nutshell, the outputs of A2 and A3 when summed, cancel each other at the fundamental but produce a third harmonic component which is in phase with the output of A1, and can be used to eliminate it by combining the signals as shown in Fig.5.

A similar argument applies for any harmonic produced by A3, and in fact all harmonics are substantially reduced by A4. The network shown in Fig.5 provides a deep notch at the third harmonic, since this is predominant as a result of the thermistor.

Wonderful – very low distortion from the thermistor and less bounce!

Electronic thermistor

Another idea came to mind during development of the prototype. If thermistor distortion is reduced because it is third harmonic, then so should distortion created by simple diode clipping of the waveform – providing the clipping was symmetrical.

A simple 'electronic thermistor' was quickly made up and installed in place of the glass bead type. The result was an oscillator which behaves like a function generator – instant settling after a range or frequency change at any frequency. But what about distortion?

Well, measured at the outputs of A1 to A3 it was about 3% (yuck) – again predominantly *third* harmonic. But at A4's output the reading was a very respectable 0.16% (mainly fifth harmonic). This amount of distortion is barely audible and not visible on a scope at all. For the great majority of purposes, an audio generator with this level of THD is entirely satisfactory.

The oscillator

The new design will be described in the form of a basic 'plain vanilla' unit, but with various options. It can be upgraded in several ways, to obtain very low distortion and good frequency stability by merely purchasing alternative grade components. Even the glass bead thermistor is an option, as most people have no need for a 0.001% THD oscillator. Thus, you can build the budget version, which still out performs many other oscillators currently available, or you can 'go the whole hog'.

The unit will include a square wave output as well as the sine wave output. The squarer circuit uses only five components, and four of these are resistors. Also, the squarer output and the sine wave output are both directly coupled to the attenuator, so the whole thing is direct coupled, eliminating any large coupling capacitors.

In keeping with the calibre of the whole project, a professional quality structors can use any case they choose, although the artwork may not fit the front panel. To completely eliminate distortion due to the power transformer's magnetic field, a standard AC plug-pack is used for mains power.

So, there it is – a rather different approach to producing a low distortion audio oscillator. Next month comes the unit itself.

We believe this low distortion oscillator will make previous designs redundant, so hold off until February before you build such a device. It will be worth the wait.

SPECTACULAR RELEASE

$799 PAIR

vifa

NEW SA-100 SPEAKER KIT

Since the introduction of VIFA speaker kits in Australia in 1985, thousands of speakers have been built with superb results. VIFA is now proud to release four new speaker kits ranging from a mere $399 to $1199 per pair including cabinets.

Never before have speaker kits been so popular in Australia than after the heavy devaluation of the dollar. Similar fully imported quality loudspeakers are today typically 2-2½ times more expensive. And these speakers may very well be using Danish VIFA drivers anyway, as VIFA supply more than 50 of the world's most respected loudspeaker manufacturers with drivers.

But why the big savings? Because fully imported speakers suffer from 25% import duty, 20-30% freight, 30% sales tax and 28% handling charges (typically). So if you would rather put your money into better quality than in other people's pockets, VIFA speaker kits are the only way to go.

Are they difficult to build? No, the kits are supplied with all parts needed including fully built crossovers and pre-cut flatpack cabinets ready to assemble. No soldering or carpentry skills are needed, just a Phillips head screwdriver, some simple hand tools and a few hours of your leisure time.

Are they as good as people say? Read the reviews, listen and compare with any other speakers twice the price or more. Need we say anymore?

VIFA for the quality conscious audiophile.

For full details please contact
Sole Australian Distributor:

SCAN AUDIO Pty. Ltd.
P.O. Box 242, Hawthorn 3122.
Fax (03) 429 9309
Phone: (03) 429 2199 (Melbourne)
(02) 522 5697 (Sydney)
(07) 357 7433 (Brisbane)
(09) 322 4409 (Perth)
Stocked by leading stores throughout Australia

RCS DESIGN

The World's leading supplier
Racal-Redac
is proud to announce an exciting new product
CADSTAR.

CADSTAR is another innovation from *Racal-Redac* and a major breakthrough in advanced high-tech PCB design

CADSTAR gives the capability of producing very dense double-sided surface mount designs.

'design right first time'

RCS CADCENTRES

A Division of RCS Design Pty. Ltd. — Incorporated in Victoria.

Unit 12, Eden Park Estate
31 Waterloo Road
North Ryde NSW 2113
Tel: (02) 806 1916
Fax: (02) 806 1909

728 Heidelberg Road
Alphington, Victoria 3078
Australia
Tel: (03) 499 6404
Fax: (03) 499 7107

This man isn't a computer expert,

yet he chose a UNI-X CompuPak kit – and assembled it in one night!

$999

Including Tax.
At this price **WHY NOT?**

Australian Personal Computer
LOW COST IBM COMPATIBLE SURVEY — OCTOBER 1987

...and the experts agree with his choice.

No, he's not a genius, but he's brilliant at spotting great value. Like many of us, he's realized that a personal computer is invaluable, yet the price tag for a professional unit has always been a little beyond his reach. Until now.

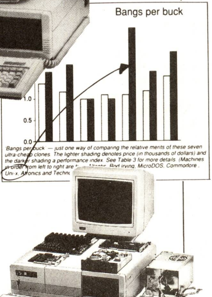
Quite simply the UNI-X CompuPak kit contains all the major componentry of a top quality Industry standard computer, in an unassembled form. You save the dollars and increase your knowledge, by putting it together yourself.

UNI-X also provide a National Warranty through Honeywell Ltd, a professional network of expert backup and service.

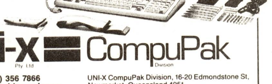
The complete Super 10 kit contains:

- ☐ **Super — 10 mother board** **640K Installed** 4.77/10MHz, plus V-20 chip (very fast!)
- ☐ **Colour graphics adaptor card.**
- ☐ **Multi I/O Card**-Serial/Parallel Ports, Games Port, Clock, calendar, Floppy Controller.
- ☐ **Dual Frequency TTL Monitor** (Green or Amber) includes tilt and swivel base.
- ☐ **Top quality Japanese Disk Drive.**
- ☐ **150 watt switching power supply.**
- ☐ **High tech flip-top case.**
- ☐ **Complete set of accessories.**
- ☐ **AT style keyboard.**
- ☐ **Industry standard — runs all IBM software.**
- ☐ **Assembly manual**
- ☐ **Utility Disk.**
- ☐ **All upgrade options available.**

Ring PATRICK SIMONIS (07) 356 7866 right now.



'Bangs per buck' — just one way of comparing the relative merits of these seven ultra-cheap clones. The lighter shading denotes price (in thousands of dollars) and the darker shading a performance index. See Table 3 for more details. (Machines in order from left to right are [illegible] Atlantis, Rod Irving, MicroDOS, Commodore, Uni-x, Altronics and Techn



UNI-X Pty Ltd **CompuPak** Division

Phone (07) 356 7866
Dealer enquiries welcome
Phone (07) 356 8311

UNI-X CompuPak Division, 16-20 Edmondstone St,
Newmarket, Queensland 4051

Australian Personal Computer have now proved what our customers have known for years

Processor.

[illegible] NEC. The Uni-x contains a NEC V20, manufactured by Sony.

This is all [illegible] Thus a V20 running at [illegible] 4.77MHz will outrun an 8088 running at the same clock speed. [illegible] claim [illegible] machines examined provided a standard PC clock rate of 4.77MHz as a minimum, although the Uni-x delivered higher than standard performance even on this clock rate by virtue of the V20. The Atlantis and [illegible] machines [illegible]

Performance.

[illegible]. The Uni-x is fastest overall, providing a 50 per cent boost over the Technology Interface due to the V20.

[illegible] interesting of all there is al[illegible]

Display.

[illegible] and the Uni-x is delivered with a nice INTRA tilt/swivel amber screen. The others [illegible]

Cost Effectiveness.

[illegible] a bang per buck.

As you might expect, the do-it-yourself Uni-x comes up trumps with its low cost and relatively high performance. [illegible]

Specifics.

very sensible place [illegible]

The Uni-x features a delightfully small motherboard. It has employed a VLSI component to replace the Intel 8253 timer, 8255 PPI, 8237 DMA controller and several other components. This reduced the component count and a simplified motherboard serves to reduce costs.

. . . see for yourself in the full Report in the October '87 issue, or ring us for a copy.

Construction Project:

TTL-Analog Video Converter

Here's a device which lets you use any analog RGB colour video monitor as a CGA colour monitor for your IBM PC or compatible. Simple to build and with lots of features, our video converter might save you hundreds of dollars.

by PETER PHILLIPS

There's no doubt about colour – it can enhance the dreariest of software. The trouble is, it costs money as even the cheapest CGA-compatible colour monitors cost around $500. There are those who would argue that CGA colour isn't worth the expense anyway, and that you should try and save up to go EGA. However, EGA costs even more, and many IBM users end up staying monochrome.

So, wouldn't it be nice to be able to adapt an existing colour TV or monitor to work with CGA output signals? This way, colour becomes possible without a great financial outlay, and you can take your time saving up for EGA if colour really takes your fancy.

This project converts the TTL RGB signals produced by a CGA output to analog RGB signals, allowing any analog RGB video monitor to be used as the display. It can even be used with composite video monitors or conventional colour TV sets – although these will need to be modified to accept RGB signals. But as RGB drive to the picture tube is a fundamental part of any colour monitor or set, this should not be a problem.

Converting the TTL signals to an analog form is only half the problem. The video synchronisation signals are sent separately by the CGA card, but many analog monitors want composite sync. OK, so that's easy enough to implement; our interface does this with a couple of gates, and offers selectable sync polarity as well.

However, with some analog monitors, the displayed picture is shifted to the left of the screen, due to the sync pulses occurring at the wrong time. To overcome this, a 'sync shift' circuit has been incorporated in the project, allowing you to centre the picture by adjusting a preset pot.

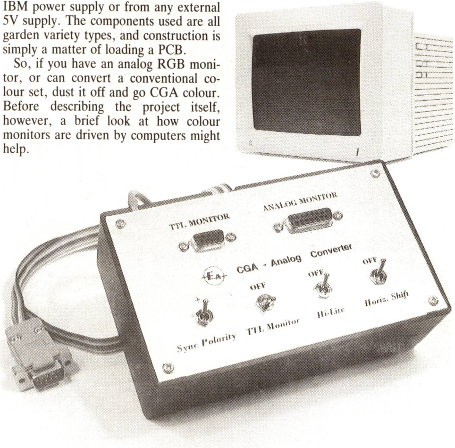
The whole project fits into a jiffy box, and derives its power from either the IBM power supply or from any external 5V supply. The components used are all garden variety types, and construction is simply a matter of loading a PCB.

So, if you have an analog RGB monitor, or can convert a conventional colour set, dust it off and go CGA colour. Before describing the project itself, however, a brief look at how colour monitors are driven by computers might help.

Computer colour

There are four basic ways computers can drive a colour monitor, although these methods can be classified into either an analog or digital technique.

Prior to the IBM PC, most home computers capable of colour generated a composite colour video signal, similar in format to that transmitted by a TV station. This signal could be either modulated for input to the antenna terminals of any colour TV set, or used as direct video to a suitably equipped monitor. The results ranged from pathetic to very reasonable, but, consis-



tent with my opening remarks, anything was better than monochrome.

A composite colour signal is very complex, as it has to include not only the encoded RGB information and the sync signals, but a sample of the colour carrier frequency. As most readers will know, the American TV standards are different to those in Australia, and a brisk trade in NTSC monitors took place for a number of years. Also, NTSC to PAL converters were produced for computers such as the Apple.

The main limitation of the composite colour video technique is the bandwidth available, limited to around 4MHz for a PAL receiver and less for an NTSC monitor. However, given a good quality composite colour monitor, driven with a direct video signal, quite good results were possible.

RGB colour

When the IBM PC hit the market, it introduced the CGA standard and popularised the TTL colour monitor. This system requires a special monitor, and operates by generating the separate RGB signals along with a fourth signal called the intensity signal. Finally, two separate signals, one for vertical sync, and another for horizontal sync are required. Thus, a TTL monitor needs six signal lines and one or more earth lines as provided by the standard CGA 9pin D-type output socket.

However, all these signals are digital, giving a rather simple system, in which any or all of the three colours are either turned on or off. This differs from an analog system, in which each colour gun is turned on by varying amounts, allowing colour mixing that can give an almost infinite range of colours.

With the basic 'on-off' system, eight colours are possible, comprising black, white, the three primary colours and the three complementary colours.

To enhance this rather limited system, the intensity signal is used to provide two levels of colour brightness available from each gun in the colour tube. This means, for example, that red can be either dull red or bright red.

Theoretically, suitable mixing of these bi-level colour signals could give a wider range of colours, but the IBM standard seems to have settled on something less than this, and a typical display merely has highlighting of parts of the text or graphics.

The remaining system is analog RGB, used by Apple for its 2GS computer, and also used by Atari, the Commodore Amiga and others. In this system, individual RGB signals are generated, but at various levels, allowing colour mixing on a much wider scale than the CGA standard. An analog colour monitor therefore needs an amplifier for each of the three colour signals, and is slightly more complex than a TTL colour monitor.

Because the CGA system is relatively poor, IBM developed the EGA standard. This system is also digital, but with four levels of individual colour intensity available, coupled with a higher *resolution* achieved with different line scan rates.

Scan rates

In fact, resolution is another aspect of the video display story as all the colours in the world are useless if the system cannot resolve them. Resolution is tied in with bandwidth and the line rate of the monitor. Bandwidth sets the horizontal resolution, and the line scan rate determines the vertical resolution. The bandwidth of the monitor is usually the main limitation, and most quality computer colour monitors are good for at least 8MHz or more.

To get more lines on the screen, and to therefore increase the vertical resolution, differing line scan rates are used, giving rise to all sorts of extra standards. For starters, the American standard has different scan rates compared to those used by the European/Australian system, which, fortunately, are sufficiently close to often not matter.

But IBM and its third party developers have added a few more, including the Hercules system with its horizontal scan frequency of 18,432Hz. The EGA scan rate is around 21kHz, and CGA uses the American standard of 15,750Hz. The Australian standard is, of course, 15,625Hz. The vertical scan frequency is usually either 50 or 60Hz, although Atari uses 70Hz for their system.

To allow one monitor to work with several standards, manufacturers have developed dual-scan, or even triple scan monitors. The most common type for the IBM is the TTL dual scan monitor that can operate from either CGA or Hercules modes. The appropriate scan rate is selected by sensing the polarity of the vertical sync pulses, in which CGA has positive sync and Hercules negative sync.

All in all, the result is a bewildering array of computer monitor standards that leaves one somewhat confused. But fortunately, the CGA scan rates are similar to those used by conventional TV sets, and by many analog type RGB monitors, making this project possible.

The project

As it happened, I had an analog RGB colour monitor (Apple) when I took the plunge and bought an IBM computer. The monochrome TTL monitor that came with the IBM had the dual scan facility to allow Hercules and CGA, supported by a dual video card in the IBM. Although the Hercules mode was my main preference, many IBM programs require CGA, as Hercules is not an IBM standard (yet).

The main benefit of CGA is the colour facility (although Hercules supports colour I'm told). So, it seemed a good idea to try and adapt the available colour monitor rather than buy another - hence this project.

Of course, as already mentioned, any colour TV set or composite monitor can be converted to RGB, by simply getting into the video amplifiers. This article cannot hope to discuss this in an indepth manner, as colour TV sets vary. But, to allow the project to be used in this application, some extra features have been included as will be described.

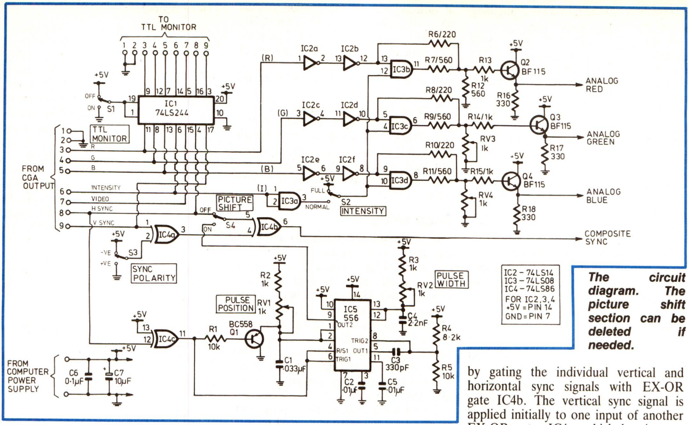
Basically, the project works like this. The TTL RGB signals are buffered, then mixed with the intensity signal to give the bi-level RGB signals required. The incoming sync signals are combined and, if selected, routed through the sync shift circuit. The sync output is therefore composite, and the polarity can be selected to suit particular requirements. Because the RGB outputs are derived from emitter followers, the circuit can drive 75 ohm inputs.

A fully buffered TTL video output is provided, allowing a conventional TTL monitor to be driven by the interface as well. This output can be turned on or off, allowing two monitors to be driven simultaneously or selected as needed.

Another facility is labelled 'Hi-Lite ON OFF'. I have found that sometimes the two levels of brightness are better replaced with all bright. Selecting 'Hi-Lite OFF' actually causes the dull sections of the display to be enhanced in brightness to equal the normally enhanced sections.

Specifications

Input: TTL RGB-(IBM CGA)
Outputs: 1 x analog RGB, positive, 3V p-p. Optional buffered TTL output
Sync: Composite, selectable polarity with adjustable timing
Power requirements: 5V at 100mA



The circuit diagram. The picture shift section can be deleted if needed.

Circuit description

A 9 pin D-plug connects the seven CGA output signals to the circuit, all of which connect to IC1. This IC is an octal three-state buffer, the outputs of which connect to the panel mount 9-pin D socket. The outputs are active when the enable inputs to IC1 are connected to a logic 0, selected by S1. This whole section could be deleted if this facility was not required.

The TTL RGB signals are buffered by IC2, a hex Schmitt trigger type 74LS14, and then fed to one input each of a two input AND gate. The other input for each of the three AND gates is connected to S2, which selects either a logic 1 (full brightness) or the intensity signal. This signal is buffered by IC3a.

The mixing process for each colour is achieved using resistive networks feeding an emitter follower. As all channels are identical, operation can be explained using one colour only, say the red channel.

The R signal, after buffering, is applied to the resistive network comprising R6, R12 and R7. If the intensity signal is low, the output of IC3b will be low, effectively connecting R7 and R12 in parallel. The potential divider action of R6 and the parallel resistors will reduce the signal available at their junction to approximately 2V, if the output of IC2b is assumed to be around 3.5V.

The output of the emitter follower (Q2) will therefore be approximately 1.5V and this signal is used to drive the red gun in the colour monitor.

If the intensity signal is high, the output of IC3b will be high, but only if the red signal is also high. Gating of the intensity signal is essential, as it is common to all three colours. Otherwise, guns not normally on would be activated by the intensity signal alone, giving some rather weird effects.

The mathematics to calculate the output signal when the intensity signal is high becomes a bit more complicated, as the resistive network now has two input voltages. In practice it works out that the signal level is now approximately 3V, or double its previous value.

To set the relative levels of all three colour signals, adjustments for the blue and green signals are provided by RV3 and RV4. The red signal level is established by R12, and the other two are adjusted for white on the screen. If the general output level is too low, R12 can be raised in value, although the maximum output signal level is limited to around 3.5V anyway.

The output emitter followers need to be able to switch quickly to give a sharp image on the screen. The specified transistors are required if the monitor has a wide bandwidth, but almost any small signal transistors could be used if a conventional TV is being used.

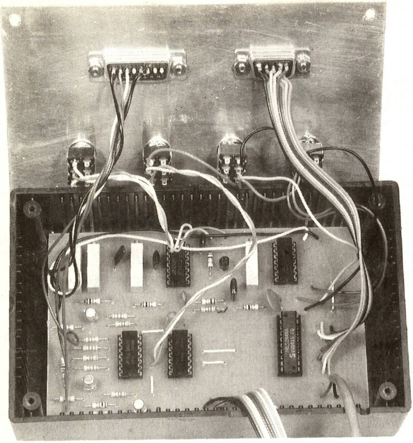
The composite sync signal is derived by gating the individual vertical and horizontal sync signals with EX-OR gate IC4b. The vertical sync signal is applied initially to one input of another EX-OR gate, IC4a, which has its second input connected to S3. If S3 connects this input to a logic 1, IC4a behaves as an inverter, otherwise it behaves as a non-inverting buffer.

Although not immediately obvious, S3 in fact selects the polarity of the composite sync, simply by changing the polarity of the vertical sync signal. This feature is included, both to accommodate different receivers, and to allow the colour monitor to operate with CGA and Hercules modes. As described previously, the vertical sync polarity is reversed between these modes, and S3 cancels this effect when selected. However, the horizontal oscillator in the monitor will need re-adjusting each time the mode is changed.

The sync shift circuit is built around a dual timer IC, type 556. It is selected by S4, which connects either direct horizontal sync, or the output of the shift circuit to the input of the EX-OR gate IC4b. The principle of operation is to alter the relative position between the video information and the horizontal sync pulse, thereby moving the picture sideways across the screen.

The circuit around IC5 compensates for the picture otherwise being positioned to the left of the screen, by, in effect, advancing the horizontal sync pulse. Delaying the sync pulse will shift the picture further to the left.

The circuit comprises one timer connected as a missing pulse detector, the



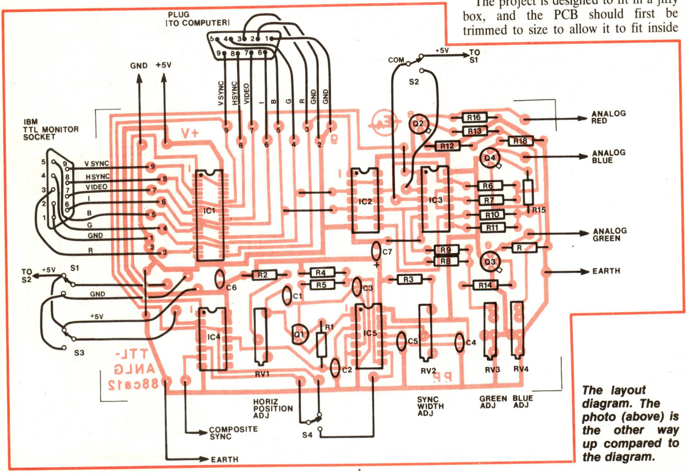
other as a monostable. The operation of the missing pulse detector relies on the timing components R2, RV1 and C1. Assuming the output (pin 5) is high, and hence the internal discharge transistor connected to pin 1 off, and Q1 off as well, C1 will charge towards 5V. If Q1 is turned on, it will discharge C1, and if this occurs before C1 has reached 2/3 of 5V (3.3V), the output at pin 5 will remain high.

However, by adjusting RV1, the timing can be set so that the output goes low and the discharge transistor turns on to discharge C1 *before* the horizontal sync pulse turns on Q1. The sync pulse is also connected to the trigger and the reset inputs of the timer, driving the output high, allowing the cycle to recommence.

The differentiator circuit of C3, R4 and R5 reshapes the output signal from the missing pulse detector so that it can trigger the monostable. The purpose of the monostable is to produce a fixed width sync pulse of around 4us. Timing components R3, RV2 and C4 establish the duration of this pulse, which is then used (if selected by S4) instead of the original sync pulse. Fig.1 shows the waveforms and their relationships.

Construction

The project is designed to fit in a jiffy box, and the PCB should first be trimmed to size to allow it to fit inside



The layout diagram. The photo (above) is the other way up compared to the diagram.

the box. Mounting the components on the PCB is relatively straightforward, and the usual order of low profile components first is recommended.

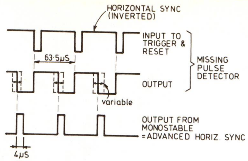
The PCB has lands for either 10 turn or conventional preset type pots for RV3 and RV4. The 10 turn types are essential for RV1 and RV2, but are not so critical elsewhere. Whatever type of pot you use, adjust each one to around 500 ohms (mid position) before installing it.

Pay particular attention when installing transistors Q2 to Q4 as the four lead configuration provides no identification of the orientation. The fourth terminal is connected to the case and is terminated to the common rail on the PCB. All ICs face the same way, and IC sockets are optional.

Once all components are mounted, take the time to confirm that there are no inter-track shorts. The track pattern around IC1 is fairly crowded, and should be examined in particular.

The final step is to connect the switches and the peripheral plugs and sockets. Before doing so, drill the aluminium lid using the artwork (or a photocopy) as a guide. The switches can be wired prior to fitting them to the lid, but the sockets need to be mounted first, then wired. The socket for the analog monitor is optional, although the 15-pin DB socket used in the prototype would probably suit most applications. The wiring of this socket will, of course, depend on the monitor being used.

Use ribbon cable for the 9-pin DB plug, cut to a length that suits your application. The panel mount 9-pin DB socket for the TTL monitor can also be connected with ribbon cable, cut to a length of around 150mm.



Timing signals for the picture shift circuit. A 555 timer as a missing pulse detector is used.

There are various way of deriving the 5V power supply. The prototype was connected to a spare disk drive power outlet within the computer. Other suggestions include finding a 5V source on the CGA card, and using one of the two earth connections available at the 9-pin socket on the card. However, you do this at your own peril. Alternatively, any external 5V supply could be used, even one built for the purpose.

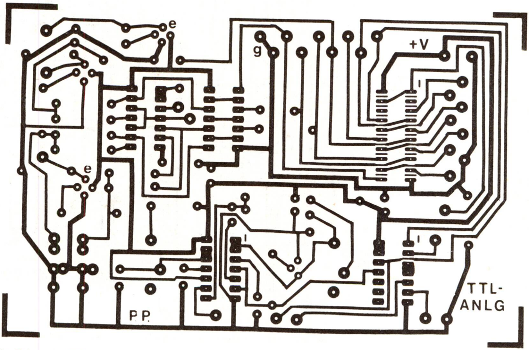
Testing & adjustment

Once convinced that the construction is correct and complete, connect an external 5V supply to confirm that the current consumption is no more than 100mA or so. Then, assuming all is well, plug the unit into the CGA card and the selected power source. With the TTL monitor plugged into the unit, it should be found that the display can be turned on or off with S1. The display should be identical to that when the monitor is driven directly from the CGA card.

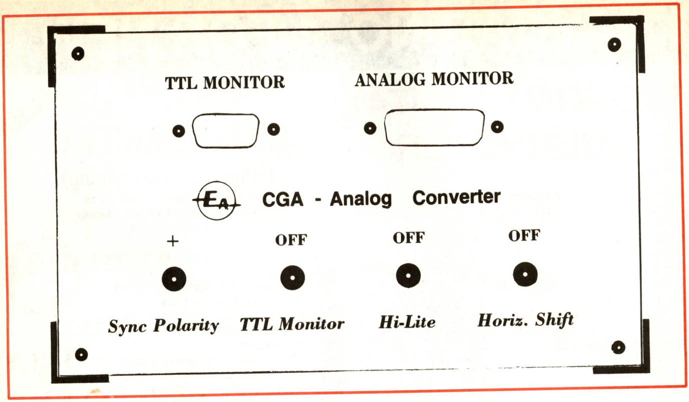
The next step is get the analog colour monitor operational. Because of the number of variables in this, it is not really possible to offer much advice. The specifications of the unit are included, and the chosen monitor will obviously need to match these. The adjustments within the unit are reasonable straightforward, and should cover most contingencies likely to arise.

The adjustment of the sync shift circuit should be left to the last, and then only if it is required. If used, adjust RV2 to give a pulse duration of around 4us. It may be that your monitor gives a centrally positioned picture anyway, meaning all the circuitry around IC5 can be deleted. Whatever happens, this unit has the facilities available if needed.

The PCB is intended to sit inside the box, and no physical means of holding it have been incorporated. A wedge could be used between the edge of the board and the side of the box if desired.



The PCB layout for those who want to make their own boards. Check carefully that the tracks around IC1 (top right) are both intact and free from inter-track shorts when this artwork is copied.



PARTS LIST

1	PCB 85 x 134mm, code 88ca12
1	Jiffy box, 50 x 90 x 150mm (UB1)
4	SPDT miniature toggle switches
2	DB sockets, 1 x 15 pin, 1 x 9 pin
1	9 pin DB plug
1	300mm length of ribbon cable

Resistors

All 1/4W, 5%: 3 x 220 ohm, 3 x 330 ohm, 4 x 560 ohm, 5 x 1k, 1 x 8.2k, 2 x 10k.

Variable resistors (pots): 4 x 10k, 10 turn (see text).

Capacitors

Disc ceramics: 1 x 330pF, 1 x 0.1uF

Metallised polyester: 1 x 2.2nF, 2 x 10nF, 1 x 33nF

Tantalum: 1 x 10uF.

Semiconductors

1	BC558 transistor
3	BF115 transistors
1	74LS08 quad AND gate
1	74LS14 hex Schmitt trigger
1	74LS86 quad EX-OR gate
1	74LS244 octal driver
1	556 dual timer

Naturally, final assembly is done only when the whole system is up and running as the trim pots are not really accessible when the PCB is inside the case. However, it's all reasonably simple, and the main task will be sorting out the colour monitor you intend to use.

Converting a TV

We remind readers that a colour TV has lethal voltages, and recommend that only those with colour TV experience actually attempt to adapt a colour set as an RGB monitor. Having said that, here are a few pointers that may assist.

Converting a conventional TV will require tapping into the video output stages of the TV. Typically, each of the three video output stages will contain a driver transistor and a video output transistor. The normal signals used in the video section are often referred to as 'colour minus luminance' (e.g., R-Y and so on). The luminance component, in normal operation, is usually added to each output stage (the Y signal) by way of a common line. Because of the absence of the Y signal in this application, it may be necessary to fake it with a DC bias.

Also, the output level from the adaptor may not be enough to give sufficient drive, nor may it be of the right polarity. This may require a further amplifier stage for each signal, either to get the inversion, the gain or both. These stages will need to operate at a voltage greater than 5V, and you could either use a 12V supply from the IBM, or build the amplifiers into the TV, using its power supply.

Many sets AC couple the signal to the output stage, and use DC restoration after. In this case, couple the RGB signals from the adaptor using a suitable value capacitor. If the output stage requires a DC potential derived from the input signal source, you may need to set up a potential divider to give this bias, and AC couple from the adaptor to the now biased input point.

A composite sync input point should not be hard to find on most sets. Normally, the output of the IF detector feeds a buffer stage, which then supplies the various parts of the TV with the composite signal, including the sync separators. You may be able to find the point that connects this buffer to the sync separator, or even apply the composite sync to the buffer input.

Unless you intend making the TV a dedicated RGB monitor, it will be necessary to use switches to isolate the RGB input function. If the set is to be a dedicated unit, then so much the better, as it can be modified without compromise.

While I have not actually had to adapt a conventional colour TV for this project, I am told by those who have done so previously that it is generally fairly easy to do. Hopefully this will be the case for you.

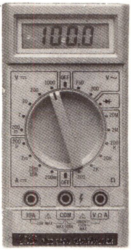
JAYCAR NO. 1 FOR NEW

ECONOMY DIGITAL MULTIMETER

Lowest Price Jaycar Digital Multimeter EVER.
Another Jaycar exclusive direct import.
Digital Multimeter at an Analog price!!

- 3.5 digit LCD display
- 20 ranges
- Diode checker
- DC 10 amp, 1000V, 0-20M ohm, etc.
- 1500 hour battery life
- One hand operation with unique feature where probes can mount into either side of the case
- Tilting bail
- Safety test leads
- 3 month warranty

Cat. QM-1410



ONLY $59.95

DIGITAL MULTIMETER

DIRECT IMPORT

(With everything!)

This really is the all singing, all dancing DMM. Jaycar's direct import saves you money again.

(Stock due mid-Feb.)

Just look at the features

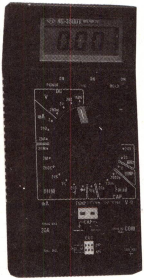
- * Frequency Counter
- * Temperature Measurement
- * Transistor Tester
- * Capacitance Tester
- * Diode Tester
- * Continuity Buzzer
- * Data Hold
- * 20 Amp Current
- * 28 Ranges

Cat. QM-1450

New for 89

ONLY

$169.00



DIGITAL MULTIMETER

DIRECT IMPORT

(With almost everything)

A Jaycar exclusive direct import.
Save a massive $50 over similarly equipped units.

LOOK AT THE FEATURES

New for 89

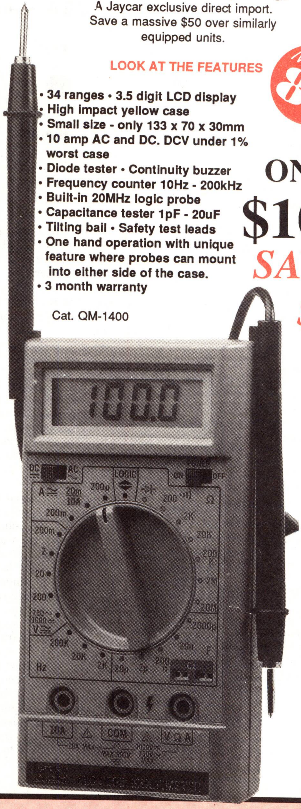
- **34 ranges • 3.5 digit LCD display**
- **High impact yellow case**
- **Small size - only 133 x 70 x 30mm**
- **10 amp AC and DC. DCV under 1% worst case**
- **Diode tester • Continuity buzzer**
- **Frequency counter 10Hz - 200kHz**
- **Built-in 20MHz logic probe**
- **Capacitance tester 1pF - 20uF**
- **Tilting bail • Safety test leads**
- **One hand operation with unique feature where probes can mount into either side of the case.**
- **3 month warranty**

Cat. QM-1400

ONLY

$109

SAVE $50



AND EXCITING PRODUCTS

8" (200mm) PLASMA LAMP

The most beautiful thing we have ever seen.

Just imagine, a beautiful plasma display in your own home for under $200!

Watch as the red glowing element in the centre of the 200mm glass sphere projects beautiful blue lightning outwards to the inner surface of the ball where it magically changes back to crimson. This event occurs simultaneously at least 50-100 times all over the inside of the sphere and is constantly in motion.

It is truly beautiful to watch.

The intensity of the display can be controlled by a slider pot mounted on the attractive base. In addition you can trigger the performance by means of a sensitive sound activated circuit.

The entire unit comes with its own dedicated power supply and is packaged in an attractive gift carton.

This beautiful instrument will give countless hours of pleasure and relaxation and is truly unique.

Cat. XP-1000

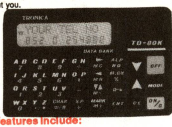
$199

PERSONAL DATABANK/ CALCULATOR UNDER $40

This personal databank will store your telephone numbers as well as being a pocket calculator. The databank has 2K memory which is 1,936 characters which will accommodate more than 100 names and telephone numbers.

It measures only 88 x 57 x 4mm thick, about the same size as a credit card. It also has a special security code, so those private phone numbers can't be retrieved by anyone but you.

DIRECT IMPORT



Other features include:

- Auto power off • Edit feature
- 10 digit calculator • Includes battery

We have seen these for as much as $79.95. But with our direct importing we can offer them at about 1/2 that price

Cat. QM-7200 **ONLY $39.95**

UNBELIEVABLE SOLDERLESS LUG PACK

Another surplus buy. A bag of approximately 200 assorted insulated solderless terminals. Included are ring terminals in many different sizes, lug terminals, cable joiners, and solderless lugs to connect into terminal block. These normally cost between 15 and 30¢ each. We estimate the normal price for these parts would be around $50.

LIMITED QUANTITY

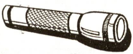
Cat. HP-1210

ONLY $10

That's only 5¢ each!

Picture represents a typical pack

Machined Aircraft-Grade Aluminium Flashlight



ONLY $9.95

What an excellent product! It measures 145mm long and runs off 2 - AA batteries. **It is 70 times brighter than a normal torch and the beam is adjustable from spot to beam, and it's waterproof and shockproof.** Durable anodised abrasion resistant finish, with a non slip knurled grip. **This torch will last a lifetime.** Small enough to fit inside a car glovebox or handbag. It can also be used as a lantern. Unscrew the top and the bulb is exposed to give 360° light.

We have seen these torches for $19.

We have direct imported them and can offer them for the amazing price of only $9.95. Cat. ST-3000

Spare bulbs available for only $1.50 (Cat. ST-3002)

1 PIECE TELEPHONE BARGAIN

A very large telephone importer/wholesaler came to Jaycar. They had a dilemma. Whenever they get a one piece phone back from a large department store, with a note on it saying "Faulty", they immediately replace it. They don't even check to see if it is actually faulty or not. We are sure that a good percentage have nothing wrong with them, but the majority will have some fault or a small problem. Electronics Australia have a six page article in DECEMBER 88 showing how to fix one piece phones. So, if you want to experiment, and end up with a cheap phone, you'd better be quick. Only $5.00 each and we'll even include the article on how to fix them, if they're faulty. (The telephone plug alone is worth $4, let alone the keypad,, cable, mic. speaker etc.,) No seven day return on this bargain.

DIRT CHEAP!!

Cat. YT-7000

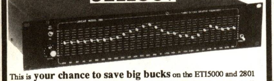
$5.00each

TURN YOUR SURPLUS STOCK INTO CASH!!

Jaycar will purchase your surplus stocks of components and equipment

CALL GARY JOHNSTON OR BRUCE ROUTLEY (02) 747 2022

28 BAND GRAPHIC EQUALISER SELLOUT



This is **your chance to save big bucks** on the ETI5000 and 2801 graphic equalisers. See our catalogue for full details. Both units are basically the same except that the 2801 has connon connectors and a power supply for 240V operation. The 5000 requires 15V, usually derived from the 5000 Amp.

2801 EQUALISER CAT. KJ-6531

WAS $239 NOW $149 SAVE $90

ETI 5000 EQUALISER CAT. KE-4204

WAS $219 NOW $129 SAVE $90

DIGITAL THERMOMETER

New

ONLY $14.95

DIRECT IMPORT

Forget those old mercury thermometers. This new digital thermometer will read in both Celsius and Fahrenheit. Celsius range 32°-43°, Farenheit range 89.6°-109.4°. Also includes buzzer alarm. We have seen these in other catalogues for as much as $29.95. Jaycars direct importing cuts out the middleman and you SAVE MONEY.

Cat. QM-6300 **ONLY $14.95**

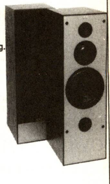
Thinking about investing in a VIFA speaker kit?

Let Jaycar tempt you into making that decision NOW and SAVE UP TO $200 PER PAIR.

All our stores have the new upgraded Vifa kits on demonstration so drop in and have a listen. Remember, you will pay about twice as much for similar pre-built, imported speakers when, in fact, they will probably have Vifa speakers in them anyway. See our1988 catalogue for full details. (Demonstration speakers are not at Concord).

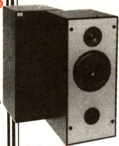
SA-130 3-way kit

complete with cabinets and crossovers .
130W RMS power handling.
Cat. CS-2485/CB-2467



SAVE $200

ONLY $999 A PAIR



SA -100 2-way kit

complete with cabinets and crossovers.
100W RMS power handling.
Cat. CS-2460/CB-2482

SAVE $100

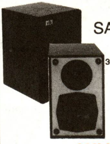
ONLY $699

SA-70 2-way kit

complete with cabinets and crossovers.
70W RMS power handling.
Cat. CS-2471/CB2472

SAVE $50

ONLY $449 A PAIR



SA-50 2-way bookshelf kit with cabinets and crossovers.
30W RMS power handling.
Cat. CS-2450/CS-2452

SAVE $30

ONLY $369 A PAIR

STOCK DUE
MID-JANUARY

SAVE UP TO AN AMAZING $200

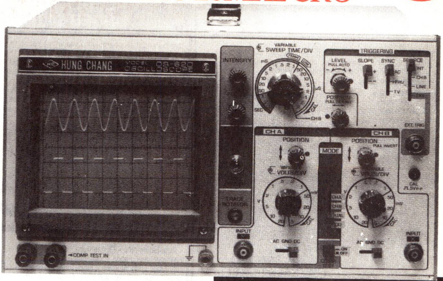
New for 89

HUNG CHANG 20MHz CRO

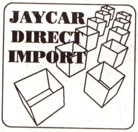
- Wide bandwidth and high sensitivity • Internal graticule rectangular bright CRT • Built-in component tester
- Front panel trace rotater • TV video sync filter
- Z axis (intensity modulation) • High sensitivity X-Y mode
- Regulated power supply circuit

SPECIFICATIONS

Effective Display Area	8 x 10 div (1 div = 10mm)
VERTICAL	
Operating Modes	CH-A, CH-B, DUAL, ADD (CH-B can be inverted)
Dual Modes	Alter; 0.2ufs - 0.5ms/div. Chop; 1ms - 0.5s/div CHOP frequency 200kHz approximately
Deflection Factor	5mV/div 20V/div ±3%, 12 ranges in 1-2-5 step with fine control
Bandwidth	DC; DC - 20MHz (-3dB), AC; 10Hz - 20MHz (-3dB)
Rise Time	Less than 17ns
Overshoot	Less than 3%
Input Impedance	1M ohm ±5%, 20pF ±3pF
HORIZONTAL	
Sweep Modes	NORMAL and AUTO
Time Base	0.2ufs - 0.5s/div ±3%, 20 ranges in 1-2-5 step with fine control
Sweep Magnifier	5 times (5x MAG)
Linearity	3%
TRIGGERING	
Sensitivity	INTERNAL; 1 div or better for 20Hz - 20MHz (Triggerable to more than 30MHz). EXTERNAL; 1Vp-p or better for DC - 20MHz (Triggerable to more than 30MHz)
Source	INT, CH-A, CH-B, LINE and EXT
Slope	Positive and negative, continously variable with level control PULL AUTO for free-run
COMPONENT TESTER	
Component Tester	Max AC 9V at the terminal with no load. Max current 2mA when the terminal is shorted. (Internal resistance is 4.7k ohm)



CRO-NORMALLY$899
NOWONLY$719SAVE$180 Cat. QC-1900
PROBES(TWO)NORMALLY$99 Cat. QC-1902
NOWONLY$79for2SAVE$20



JAYCAR
DIRECT
IMPORT

TOTAL PRICE FOR CRO
& TWO PROBES
ONLY$798
SAVE$200

4164 64K MEMORY BARGAIN

200ns variety Cat. ZZ-8420
Normally $4.95
Now Only $2.95 each

41256 RAM

Yes, we have stock of this unbelievably hard-to-get part.
256K RAM, 150ns Cat. ZZ-8453
$22.00 each 10up *$20.00* each

BRAND NEW
MASSIVE
148 PAGE
JAYCAR
CATALOGUE
OUT NEXT
MONTH
DON'T MISS OUT
ON YOUR COPY
FREE
in Silicon Chip and
Electronics Australia

VERBATIM DISCS AT UNREAL PRICES

JAYCAR No.1 FOR DISCS

Compare our prices with your normal supplier

Description	1-9 Boxes	10+ Boxes
3.5" 1S/2D Cat. XC-4720	$39.95	$37.95
3.5" 2S/2D Cat. XC-4721	$46.95	$43.95
3.5" 2S/HD Cat. XC-4722	$99.00	$89.00
5.25" 1S/2D Cat. XC-4725	$22.00	$21.00
5.25" 2S/2D Cat. XC-4726	$26.00	$24.00
5.25" 2S/HD Cat. XC-4727	$41.00	$39.95

---

30 PIECE ENGINEER'S DRIVER SET

At last! A driver set incorporating those obscure shaped heads!
Have you ever needed to service an electric tool? Chances are you would not have been able to do so because the screws holding the appliance together had strange shaped heads. Well now you can with our 30 piece driver set! This set contains all the driver bits you are EVER likely to encounter (See Below). Basic to the set is an 8 1/2" Chrome-Vanadium driver which will accept any of the 28 hardened steel bits supplied. All held in the socket by a small magnet - so you can use it in any position. The screw-together hollow handle will hold several tips so you don't have to take the whole set with you into the field. There is a tip here to suit almost any screw/nut you may come across.

Here's what you get:

- **5 Slotted Bits 0-1, 3-4, 5-6, 8-10, 12**
- **5 Hex Bits 3/32", 5/64", 7/64", 1/8", 9/64"**
- **4 Philips Bits No. 0, 1, 2 & 3**
- **4 Square Recess Bits No. 0, 1, 2 & 3**
- **6 Torx Bits T10, T15, T20, T25, T30, T40**
- **2 Pozidrive Bits No. 1 & 2**
- **1 x 1/4" Drive Socket Adaptor**
- **1 x 1/4" Drive Hex Bit Holder**

And its all housed in a sealable tough plastic case.

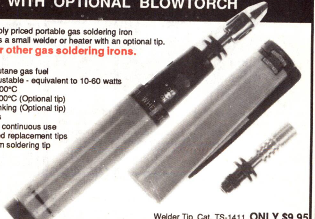
Cat. TD-2000 $19.95

GASSOL PORTABLE SOLDERING TOOL WITH OPTIONAL BLOWTORCH

At last. A reasonably priced portable gas soldering iron that can double as a small welder or heater with an optional tip.
Save $10 over other gas soldering irons.

- Use anywhere
- Uses standard butane gas fuel
- Temperature adjustable - equivalent to 10-60 watts
- Soldering up to 400°C
- Welding up to 1300°C (Optional tip)
- Use for heat shrinking (Optional tip)
- Refills in seconds
- Up to 60 minutes continuous use
- Reasonably priced replacement tips
- Includes one 1mm soldering tip

Cat. TS-1410
ONLY
$29.95



Welder Tip Cat. TS-1411 **ONLY $9.95**
Spare soldering tip 1mm Cat. TS-1413 **ONLY $9.95**

FANTASTIC NEW KITS FOR '89

MINSTREL 2/30 SPEAKER KIT

Refer Silicon Chip Feb 89

Jaycar and Silicon Chip proudly present the first in a series of quality, economical speaker kits.
These popular bookshelf type speakers will handle 60W RMS!

AND

They perform extremely well, showing a good overall balance between speakers and a very flat response through the tonal range.

Just look at these features:

- ***high efficiency - 96db - 1Watt/1meter***
- ***pre-built crossovers with aircore chokes***
- ***small size - 490(H) x 303(W) x 290(D)mm***
- ***Recessed push terminals on rear***
- ***quality black cabinets with removable grills***

Cat. CS-2540 **Speakers** **$149.00**

Cat. CS-2542 **Cabinets** **$129.00**

If purchased together ***only$269.00 complete***

TTL - ANALOG VIDEO CONVERTER

Refer EA Feb 89
This kit will allow you to use anu analog RGB colour video monitor as a CGA colour monitor for your IBM PC or compatible. Kit includes PCB, box, panel, D sockets and plug and all specified components.

Cat. KA-1711 ***$49.95***

PCB SHORTS LOCATOR

Refer EA Feb 89

This simple kit will help you locate shorted tracks on printed circuit boards by means of a varying audio tone. It's easily built and much cheaper than commercial units.

Cat. KA-1712 **$22.95**

MAINS MUZZLER

Refer Silicon Chip Jan 89

A line filter kit for your computer which incorporates an effective filter for mains borne interference and a varistor to clip dangerous spike voltages. Kit includes PCB, box (HB-5446) 4 mains sockets and all specified components.

Cat. KC-5046 **$55.00**

BETA TESTER

Refer Silicon Chip Feb 89

Great NEW kit. Will measure the gain of a transistor, test NPN, PNP and power transistors, PLUS, by trial-and-error, you can identify BCE on an unmarked device. Kit includes PCB, box and all specified components.

Cat. KC-5047 ***$18.95***

BEEPO

CONTINUITY TESTER

Refer EA Feb 89
This all-singing, all-dancing continuity tester kit features three audio tones, operation over six decades of resistance, auto-poiarity reversal, and an ambient current so low, it needs no ON/OFF switch.

Kit includes PCB, box and all specified components. Batteries extra (Cat. SB-2369 $4.35 for 2 Alkaline)

Cat. KA-1710 **$19.95**

Jaycar ELECTRONICS

HEAD OFFICE
115 Parramatta Road Concord 2137
Telephone (02) 747 2022
Telex 72293
FACSIMILE (02) 744 0767

MAIL ORDERS
P.O. Box 185 Concord 2137
HOTLINE (02) 747 1888
FOR ORDERS ONLY
TOLLFREE (008) 022 888

POST & PACKING

$5	$9.99	$ 2.00
$10	$24.99	$ 3.75
$25	$49.99	$ 4.50
$50	$99.99	$ 6.50
OVER $100		$10.00

MAIL ORDER VIA YOUR ☎ ROAD FREIGHT ANYWHERE IN AUSTRALIA $13.50

AMERICAN EXPRESS VISA bankcard MasterCard

SYDNEY - CITY	117 York St. (02) 267 1614 - Mon-Fri 8.30 - 5.30 Thurs 8.30 pm - Sat 9 - 12
PARRAMATTA	355 Church St (Cnr. Victoria Rd) (02) 683 3377 Mon-Fri 9 - 5.30 Thurs 8.30 pm - Sat 9 - 2pm
CONCORD	115 Parramatta Rd (02) 745 3077 - Mon-Fri 8.30 - 5.30 - Sat 8.30 - 12
HURSTVILLE	121 Forest Rd (02) 570 7000 - Mon-Fri 9 - 5.30 Thurs 8.30 pm - Sat 9 - 12
GORE HILL	188 Pacific Hwy (Cnr. Bellevue Ave) (02) 439 4799 Mon-Fri 9 - 5.30 Sat 9 - 4pm
BURANDA QLD	144 Logan Rd (07) 393 0777 - Mon-Fri 9 - 5.30 Thurs 8.30 - Sat 9 - 12
MELBOURNE-CITY	Shop 2, 45 A'Beckett St City (03) 663 2030 Mon-Fri 9 - 5.30 Fri 8.30 - Sat 9 - 12
SPRINGVALE VIC	887-889 Springvale Road Mulgrave (03) 547 1022 Nr Cnr. Dandenong Road Mon-Fri 9 - 5.30 Fri 8.30 - Sat 9 - 2

Construction project:

Universal "Real World" Interface for PCs – 4

In this, the final instalment of our real world interface project, we present three boards to facilitate connection of the main board described previously to external devices. These provide a choice of either four isolated Triacs or four relays for power control, and eight opto-isolated digital inputs.

by MARK CHEESEMAN

As it stands at the moment, the main board for our Real World Interface cannot be connected to many real-world devices at all. Connect an electric motor, for example, to one of the outputs of the main board and very little will happen.

What we need now is some form of driver circuit to enable the main board to be connected to, and also isolated from, external loads. This driver circuit will allow the output latches to control loads well beyond those that can be handled by the latch outputs alone.

In fact, there are two different driver circuits. One uses Triacs, and is intended for controlling AC loads; the other uses relays, and is designed to switch AC or DC loads.

In addition, it would be convenient if the digital inputs were able to monitor AC and DC voltages outside the range allowed for by the input latch on the main board. To this end we are also presenting an opto-coupled input board in this article.

The latter board consists of eight identical sections, amounting to one for each of the digital inputs on the main board. Each section has an optocoupler (of course!), with the collector of its output transistor connected to +5V, and a resistor between its output and ground. Connected up in this manner, each bit of the digital input latch reads a '1' when the LED in the appropriate optocoupler is on, and a '0' otherwise.

The LEDs each have a series resistor R1 to limit the current through the LED. An optional input diode and capacitor form a half-wave rectifier to allow monitoring of AC voltages.

Output drivers

As mentioned above, there are two different output modules. One has four relays on it, and is capable of controlling AC or DC loads, up to the rating of the contacts in the relays themselves. Each relay coil is driven by a transistor, which in turn obtains its base current from the appropriate Q output on the main board. 1N4002 diodes across the relay coils protect each transistor from the large reverse voltage spikes generated by the coil when the transistor turns off.

The other driver board contains four Triacs, for switching AC loads only. The Triacs are triggered by special optocouplers, which themselves have high voltage Triacs as their output element, and each of these controls the gate of one of the main Triacs.

The series combination of R1 and R2 limits the current through the Triac in the optocoupler, and C1 'snubs' the triac in the optocoupler, to ensure that the circuit turns off when the LED in the optocoupler is turned off. In addition, an ordinary LED is connected in series with the LED in the optocoupler, both to provide an indication of the logic state of each channel on the Triac board, and to assist in de-bugging software without having loads connected to the Triacs.

The AC sides of the four Triacs are completely independent from one another, so that they need not all control loads connected to the same supply.

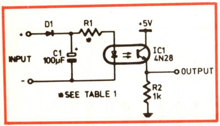
The three completed boards. At the rear is the triac board in its enclosure, with the relay board in front and the input board in the middle.

This also allows individual fuses to be connected in the supply side of each Triac circuit, rather than the load sides, for increased protection.

Construction

Construction of the relay driver and optocoupled input boards is relatively straightforward, so we will look at these first. The Triac board itself is no more difficult than the other two, but if it is going to be used to switch 240V loads there some important safety considerations which must also be taken into account, which we'll get to later.

The optocoupled input board can accommodate up to eight identical isolating circuits, allowing isolation of the full complement of digital inputs on the main board. However, if you do not need all eight inputs, or only need some of the inputs to be isolated, then you can simply omit the components for the sections you don't need.

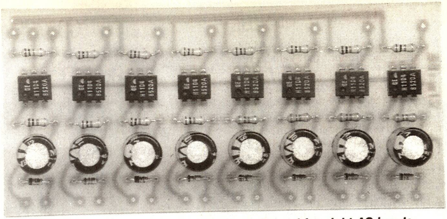


This is the circuit diagram for one section of the optocoupled input board. D1 and C1 are required for AC inputs only.

TABLE 1

Values for R1 in optocoupler input board.

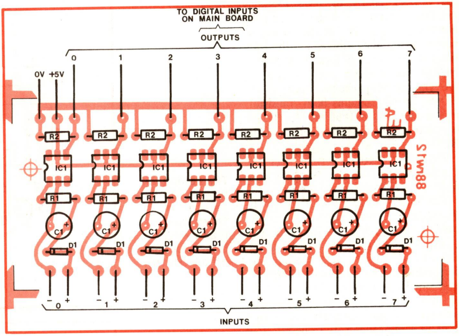
R	AC Volts	DC Volts
680 ohm	3.5V	4.5V
1k	4.5V	6V
1.5k	6V	9V
2.2k	9V	12V
3.3k	12V	16V
5.6k	18V	25V

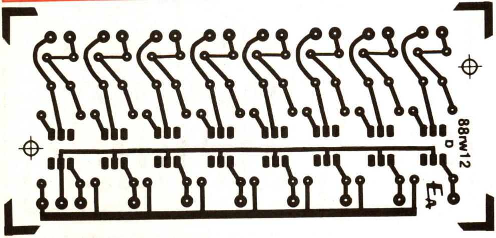


The completed input optocoupler board, configured for eight AC inputs.

As discussed in the circuit description, either AC or DC voltages may be applied to this board. If you wish to monitor AC voltages, the track connecting the diode pads of the relevant section should be cut with a sharp knife or scalpel. For DC, the track is left in place, as the diode is not necessary in this case.

After cutting the necessary tracks, insert the diodes in the required places, making sure you get their polarity cor-





Above is the component overlay for the input board, with all optional components installed for AC inputs. Omit the diodes and capacitors on those inputs which will be monitoring DC voltages. At left is the full size artwork for the same board.

rect. Next, insert the resistors, using Table 1 to determine the values required for R1 in each section. Finally mount the required capacitors and the optocouplers, again being careful with polarity.

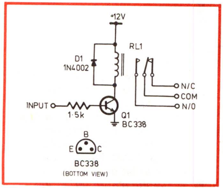
The assembly of the relay board is the simplest of the three, with a total of 16 components, not including the PCB itself and the optional terminal strip.

First mount the four resistors and the four diodes, followed by the transistors. The four relays may be mounted next. We used single-pole double-throw relays with a contact rating of 5A, as they seemed to be a good compromise of cost and rating, and are also widely available from most suppliers.

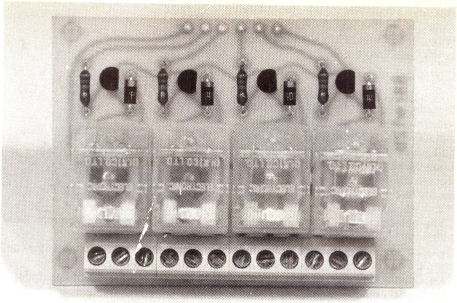
If you want to use different relays, you'll need to mount them off the PCB (or design your own board). If the relays that you choose have a coil current of over 100mA, the transistors may not fully saturate, and the circuit may not work reliably. In this case, it will be necessary to either supplement the transistor with another to form a Darlington configuration. Better still, use one of the Darlington packages, such as the BD681, which contains both transistors in a single package (but beware, the pin connections are different to that of the BC338).

The other alternative is to keep the existing relay, and use its contacts to control the coil of the larger one.

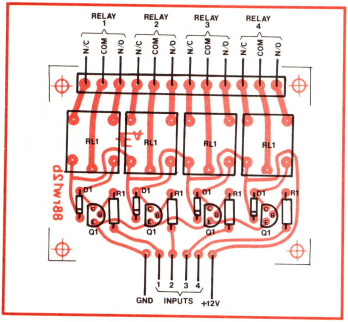
The final thing to mount is the PCB-mounting terminal strip, if one is desired. These are available in a variety of numbers of terminations, and are stackable end-to-end, to give the total number of terminations required. Therefore, any combination of these giving a total of 12 terminals would be suitable. The advantage of using such terminals is that it allows large gauge wire to be attached to the PCB with ease, and also allows re-wiring with a minimum of fuss,



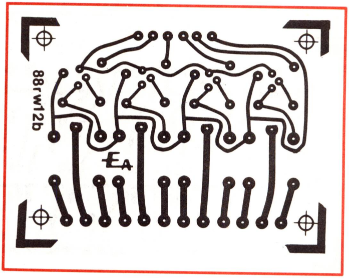
The circuit for one section of the relay output board.



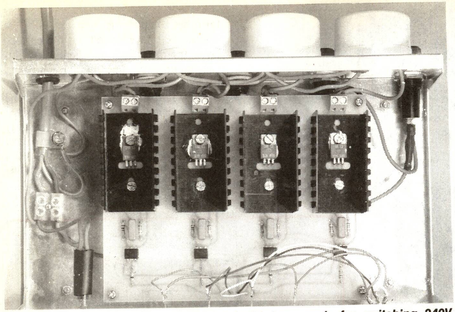
The completed relay board. Note the terminal block for the connections to the contacts.



The component overlay for the relay board. Other types of relays will have to be mounted off the board.



Here is the actual sized artwork for the relay PCB.

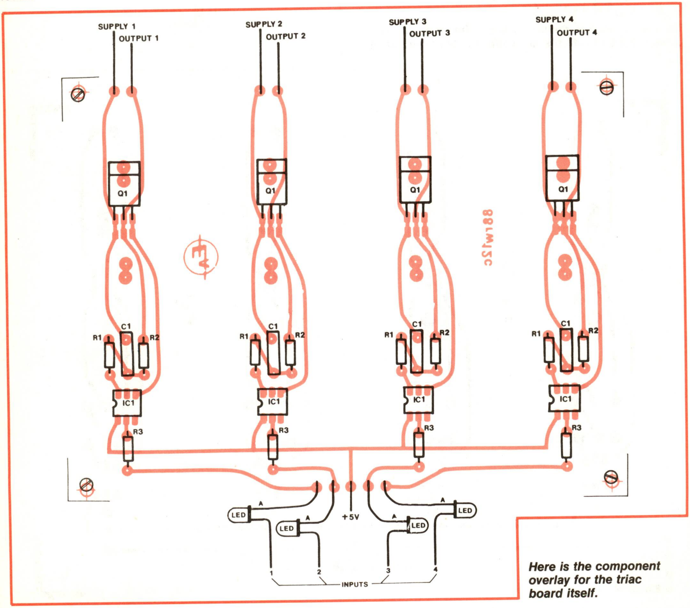


The assembled triac board, mounted in its box, ready for switching 240V loads.

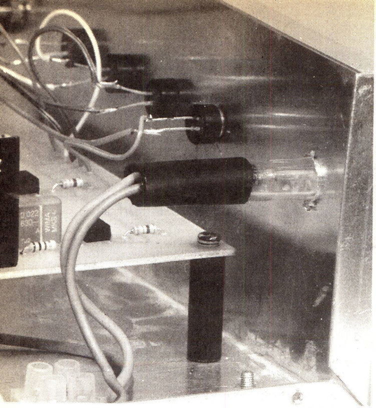
should this be required at some future time.

The Triac board is physically the largest of the three, as the heatsinks for the Triacs take up a fair amount of space. We used commonly available U-shaped heatsinks, which are capable of accommodating either TO-3 or TO-220 packages. However, we found that there appear to be two different versions, with slightly different spacings for the mounting holes relative to the heatsink outline.

For this reason, the PCB design allows for both arrangements. Thus, before mounting any components, you should determine which set of mounting holes is appropriate for the heatsinks which you are going to use. This can be determined by placing the heatsink over each sets of holes, and finding out which position does not cause the heatsink to collide with the mounting holes



Here is the component overlay for the triac board itself.



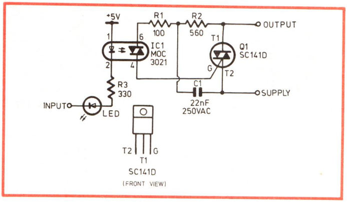
The connections to the power neon should be sleeved to prevent contact with the low voltage side of the circuit.

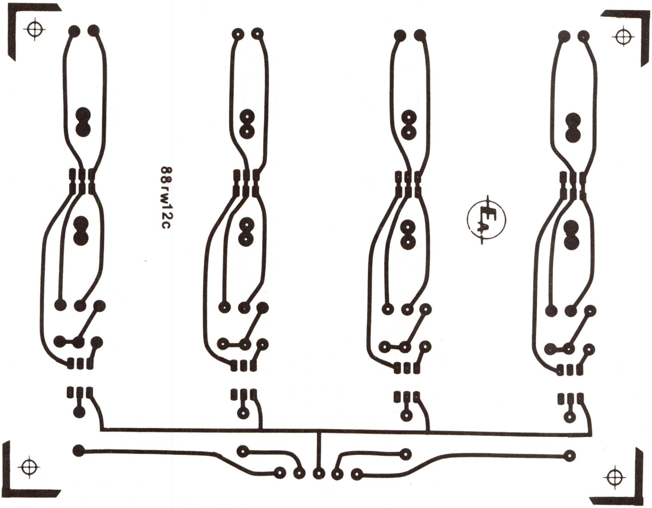
for other components.

Once you have drilled out the correct holes for the Triacs and heatsinks, you can mount the optocouplers and the passive components.

Note that the capacitors should be types specifically rated for 250V AC working. You *may* be able to get away with 630V polyesters, but they have been known to fail occasionally when subjected to mains potential continuously.

Below is the circuit for one of the four channels on the Triac output board.





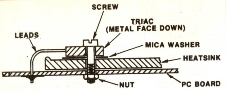
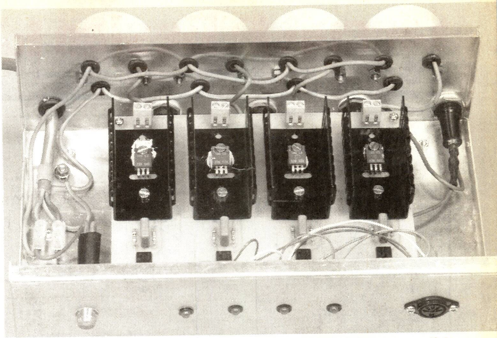


FIG. 3 : TO-126 MOUNTING METHOD

Cross-sectional view of the Triac assembly, showing the heatsink and insulating washer.



Take care with the 240V wiring. Note the grommets behind the power outlets to protect the wiring, and the cable clamp on the input cable.

Next, mount the heatsinks and Triacs, making sure that you position them so that the leads to the Triacs clear the hole in the heatsink by as large an amount as possible.

For maximum safety, you should insulate the Triacs from the heatsinks, using mica washers. Apply a film of heatsink compound to both sides of the washer before assembling them according to Fig.1.

Provision has also been made on this board for PCB-mounting terminals, for the supply and load connections. These are mounted in pairs adjacent to the appropriate heatsinks.

Although all of the other boards in the real-world interface are presented 'as is', without any enclosures, we decided that for safety reasons a suitable enclosure should be presented for the Triac board, as it is likely that it will be used to control 240V loads, leaving much of the board at mains potential.

We used an aluminium and steel K&W instrument case, measuring 255 x 77 x 155mm. Four 3-pin mains sockets, four fuses and a grommeted hole for the mains power cable are accommodated on the rear panel, as shown in the photographs.

Mount the fuses as low as possible on the panel, so that the PCB will clear them when mounted inside the box. We used 25mm insulated spacers to mount the PCB, which provided adequate clearance above the fuses.

The wires passing through the rear panel to the sockets should be passed through grommeted holes (three per socket), to prevent sharp edges on the panel cutting through the insulation of the wire.

A 5-pin DIN socket was used to connect the TTL level signals from the main board to the Triac enclosure. This is mounted on the front panel of the box, with the four indicator LEDs, and a neon indicator to show when mains power has been applied to the circuit.

When assembling the box for the Triac board, you should, as far as possible, ensure that all mains wiring is as far away from the low-voltage parts of the circuit. If you follow the wiring diagram and the photographs, you should have no difficulty in achieving this.

Make sure that the box is soundly earthed for safety, and also that the earth pins of the output sockets are connected to the earth pin of the plug. Once you have connected the board to the other components in the box, have a little break, and then carefully check your work, as any mistake could have dangerous consequences.

That's about it, apart from connecting the new boards up to the main board and checking out the completed system.

We have not presented any enclosures for the various boards (except for the Triac board above), as the enclosure required will depend on the intended use of the finished project, and how many of which boards you need.

Now you're ready to control the world!

PARTS LIST

Input board

1	PCB coded 88rw12a
8	4N28 optocouplers
8	1k 1/4W 5% resistors
8	1/4W 5% resistors (see Table 1)
8	100uF 63VW electrolytic capacitors (optional, see text)
8	1N4148 diodes (optional, see text)

Relay board

1	PCB coded 88rw12b
4	1.5k 1/4W 5% resistors
4	BC338 transistors
4	1N4002 diodes
4	SPDT PCB mount relays
4	3-way PCB mount terminal strips

Triac board

1	PCB coded 88rw12c
4	100 ohm 1/4W 5% resistors
4	330 ohm 1/4W 5% resistors
4	680 ohm 1/4W 5% resistors
4	22nF 250V AC polyester capacitors
4	SC141D Triacs
4	MOC3021 Triac optocouplers
4	red LEDs
4	U-shaped heatsinks
4	2 way PCB mount terminal strips

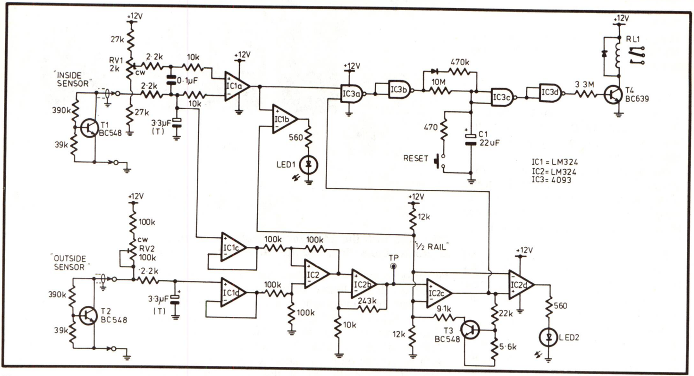
Additional components for Triac enclosure:

1	K&W instrument case, measuring 255x77x155mm
4	25mm insulated stand-offs
4	3-pin mains sockets
4	3AG fuse holders
4	3A 3AG fuses
1	5 pin DIN socket
1	240V neon bezel

Cable clamp, rubber grommets, mains terminal block, nuts and bolts, mains flex and plug.

Circuit & Design Ideas

Interesting circuit ideas from readers and technical literature. While this material has been checked as far as possible, the circuits have not been built and tested by us. As a consequence, we cannot accept responsibility, enter into correspondence or provide constructional details.



Fan controller

This cooling fan controller circuit will turn exhaust fans on and off to extract hot air from a house (or shed) when the outside temperature drops.

The fan comes on only when the temperature inside rises above a preset value as set by RV1, and a differential exists between the inside and outside temperatures (RV2). The outside temperature must be less than inside.

The circuit works in the following way. T1 and its associated resistors act as the internal sensor. This configuration produces an output change of approximately – 24mV/°C. T2 is the outside sensor.

IC1a is a comparator, comparing the preset (RV1) voltage with that from the internal sensor. IC1b drives LED1 to indicate that the inside temperature is above the preset.

IC1c and IC1d are voltage followers feeding differential amplifier IC2a. The output of this amplifier is further amplified in IC2b by a factor of 25, (for a nominal 3V at the T.P. with no difference between the sensor temperatures).

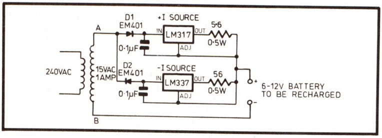
IC2c is a comparator with hysteresis introduced by T3. The 'half rail' point normally sits at 6V until the voltage at the T.P. exceeds 6V (5°C differential). When this occurs, the 'half rail' point is pulled down to approximately 3.6V by T3, which is now turned on. IC2d drives LED2 to indicate the differential has been reached.

When the conditions of a high inside temperature and a large differential between the inside and outside temperatures are reached, IC3a and IC3b respond and supply a charge to C1. If after 2 minutes these conditions still exist, the relay operates via IC3c and IC3d driving T4.

The fan is therefore switched on by the relay contacts. When the differential ceases, or the inside temperature drops below the preset value, the relay will open, turning off the fan.

E. Rodda,
Marion, SA

$60



Multiple dry cell recharger

Articles on recharging single alkaline or carbon cells using periodic current reversal techniques have appeared in various overseas electronic magazines recently. However, none have been designed to recharge multiple dry cell batteries.

This circuit applies AC directly across the battery to be recharged. When point A is positive compared to point B, current flows through D1 and a positive constant current source (LM317 and the 5.6 ohm resistor) of around 215mA, charging the battery.

When A is negative to B, a constant current of about 20mA is taken from the battery via D2 and the negative con-

Recharger for single dry cells

This circuit will recharge a dry cell in 12 hours, and can be powered by any 9V DC source.

Readers who doubt the safety of recharging dry cells can refer to the June and July 1986 issues of the British magazine *Practical Electronics*, which discusses periodic pulse recharging.

The circuit values are for one AA cell. To recharge C and D cells, lower the value of Rx to 68 ohms. Recharging cells in series should be avoided, as it can damage the cells.

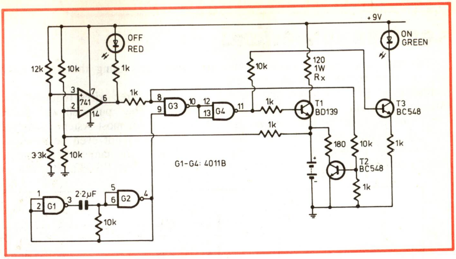
Gates G1 and G2 form a squarewave oscillator. The oscillator output is gated by G3, controlled by the op amp which is connected as a comparator. The output of G3 is buffered by G4, which in turn drives transistor T1.

If the cell voltage is below 1.6V, charging can occur. When the battery voltage approaches 1.6V, the comparator output will start to vary, causing both LEDs to flicker. This form of self regulation will prevent the cell from overcharging.

Transistor T2 provides a small amount of reverse current which increases charge retention. The cells must have been recently discharged and to no less than one volt (measure no load), or they will not hold a charge.

D. Yates
Frenchs Forest, NSW

$40



Propeller tacho

This circuit was developed to measure the RPM of a model aeroplane propeller. The circuit can be broken down into three parts; the transducer, the signal conditioner and gating section, and the timebase and display.

The transducer (IC6) used was a TL-172C Hall effect switch from Texas Instruments. The switch is normally off but conducts when a magnetic field of sufficient strength is present. The device has an inbuilt signal conditioner, hysteresis function and an output transistor, making it ideal to interface to digital electronics.

The output signal from the transducer is further conditioned by a Schmitt trigger (IC5) to eliminate noise induced in the connecting cable. This IC also gates the input signal for the required sampling time.

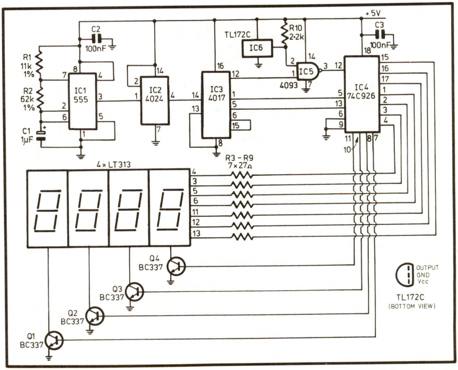
The gating period is generated by the timebase, which consists of a 555 timer operating in astable mode at a frequency of 10.67kHz. This frequency is then divided by two further stages, firstly by IC2 acting as a prescaler of 64. The output of IC2 is further divided by 10 using IC3, which results in a gating period of one minute.

IC3 is also used as a sequencer, repeating a set of prescribed operations. Initially it enables the latches of IC4, loading the information in the counter to the display latches. This occurs when pin 1 of IC3 is high. The information is then displayed on the four 7-segment LED displays. The internal counters of IC4 are reset when pin 5 of IC3 goes high and the sequence continues as the input from IC5 increments the counter accordingly. This sequence prevents the counter from incrementing continuously.

To ensure a steady power supply, 100nF monolithic ceramic capacitors are connected across both the timebase generator and the counter. Any external power supply should have these as well.

A. Fong,
Carlingford, NSW

$50



stant current source comprising the LM337 and the 56 ohm resistor.

The circuit is suitable for 6, 9 or 12V lantern batteries, and seemed to work just as well with nickel cadmium batteries. A timer could be added to limit the charge time. Also, the LM317 should be on a small heatsink.

G. Freeman,
Nairne, SA

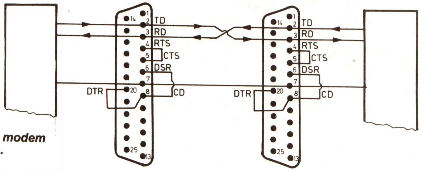
$30

Common connections

This data sheet brings together some of the more commonly used standard connections. Like all standards, there are variations, in which the RS-232 is the prime example. To help unravel the RS-232, we have shown the so called 'null-modem' connection, which is the basic interconnection required between two computers using this serial interface.

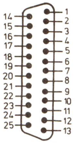
There are three wires required as a minimum. The pins shown linked should cater for most systems, although these links may not even be necessary anyway. Also, the names of each pin associated with the RS-232 standard are listed, using the DTE device as the reference.

To add variety, we have also included the MIDI interface and a couple of audio connections. Also shown is a 9 pin to 25 pin RS-232 conversion, which is applicable to the IBM (and clones) computer.

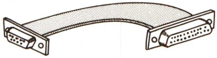


RS-232 Null modem connections.

Pin	Signal	Pin	Signal
1	Protective ground	14	Secondary transmitted data
2	Transmit data (TD)	15	Transmit signal element timing
3	Receive data (RD)	16	Secondary received data
4	Request to send (RTS)	17	Receive signal element timing
5	Clear to send (CTS)	18	Unassigned
6	Data set ready (DSR)	19	Secondary request to send
7	Signal ground	20	Data terminal ready (DTR)
8	Carrier detect (CD)	21	Signal quality detector
9/10	Reserved	22	Ring indicator
11	Unassigned	23	Data signal rate
12	Secondary data carrier detect	24	Transmit signal element timing
13	Secondary clear to send	25	Unassigned

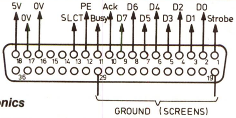


DB25 pins.

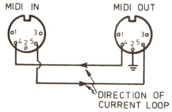


9 pin to 25 pin RS-232 conversion.

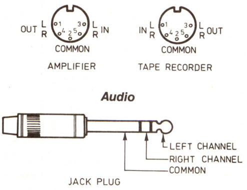
DB9	DB25	Signal
1	8	DCD
2	3	Received data
3	2	Transmit data
4	20	DTR
5	7	Signal ground
6	6	DSR
7	4	RTS
8	5	CTS
9	22	Ring indicator



Centronics

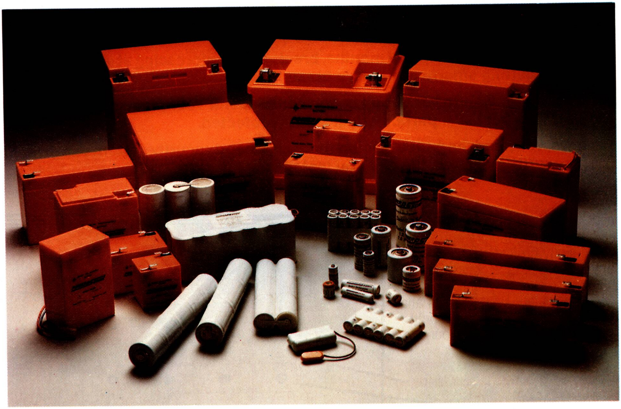


MIDI



Audio

4 REASONS TO CHOOSE POWER-SONIC BATTERIES



PERFORMANCE

Bold claims are made by battery manufacturers old and new claiming one "breakthrough" or another. The fact is, only time will tell the true quality of a product. POWER-SONIC has been building sealed rechargeable batteries for over 20 years and its state-of-the-art design and unmatched track record for dependable performance have earned it the confidence of engineers and buyers the world over.

VALUE

POWER-SONIC batteries may not always be the lowest priced on the market, but you get what you paid for – trouble-free service for years, enhancing the reputation of your product or installation. Success is measured by the bottom line, not short-sighted savings gained at the expense of high quality components.

RELIABILITY

You can rely on POWER-SONIC sealed rechargeable lead-acid and nickel-cadmium batteries in the toughest environment – be it extended power outages, high or low ambient temperatures, months of storage, or years of service. POWER-SONIC batteries are designed to power your equipment when needed. You can depend on it and so can your customer.

AVAILABILITY

A full line of standard sizes is available along with a few unique but well conceived special designs. This extensive array of models, recognized by U.L.'s component program, puts design and sourcing flexibility at your fingertips. Fully stocked warehouses allow off-the-shelf shipments and guarantee on-time deliveries.

POWER PS SONIC

POWER-SONIC CORPORATION
Vic: 9/260 Wickham Road, Moorabin, Victoria 3189
Tel: (03) 553 4195. Fax: (03) 553 4917
NSW: Unit 5/60 Fairford Rd., Padstow, 2211
Tel: (02) 790-4444 Fax (02) 790-0246

ALARMING

You've seen the reports in the newspapers: burglary is on the increase.

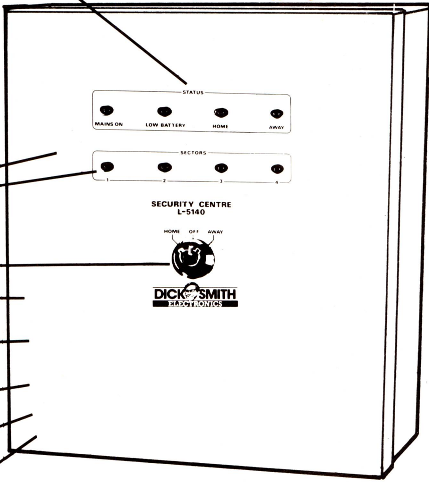
Everyone knows someone who's been robbed!

It's a fact: after a lull of a couple of months, break-ins are increasing at an alarming rate. Burglars are getting smarter and more brazen.

Haven't been broken into yet? Don't be too complacent! Your place could be the next on the burglar's 'hit list' – particularly if it isn't protected.

These days, you need the peace of mind that only a good security system can give. And the best security system is the one you install yourself.

Our new Alarm Control Unit is perfect for the home, office, factory . . . anywhere. Fully professional quality (it's actually based on a commercial module) but so simple for the home handyman to install. Do it yourself and save a fortune AND you'll be the only one who knows the details of your own system & wiring!



LED status indicators tell you what's happening.

Heavy duty steel case with in-built tamper protection.

4 individually controllable sectors for maximum versatility.

Key-lock switched for maximum security.

Inbuilt battery charger for your standby battery (fits inside case).

Mains power supply included.

Advanced circuitry minimises false alarms, fully complies with noise pollution regulations.

Siren oscillator built in suits standard horn speakers no expensive sirens to buy!

Constant 12V output for PIR's and other accessories PLUS switched 12V (alarm) output for strobes, alarm diallers, etc.

Cat L-5140

$199

Manufactured exclusively for

DICK SMITH
ELECTRONICS

NEWS

CRIME WAVE
HOMES DOGGED BY CAT BURGLAR!

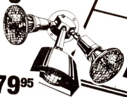
Don't let your place be next on the list!

And to complete your system ...

Vibration Sensor

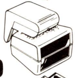
Easy to install, detects vibration and shock in windows, doors, ceiling, etc. With adjustable sensitivity. Cat L-5250 **Only $5.95**

Infrared Detector ... Security Lights



A fantastic idea for entrance ways, verandahs, etc. Features two spot lights which are turned on when movement is sensed. Lights can be set at any angle for maximum coverage. Lamps not included. Cat L-5335 **$79.95**

Passive Infrared Detector



The best, most versatile sensors you can get for your alarm — and this one's value plus! Covers an area 6m × 6m. Comes with mounting bracket. Cat L-5009 **$89**

Magnetic Reed Switches

The most reliable, yet simple form of window/door protection. Surface type (suit aluminium windows etc). Set of magnet and switch. Cat L-5210 **$3.95 ea**

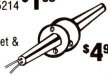
Individual Switch

Cat L-5215 **$2.95**

Individual Magnet

Cat L-5214 **$1.95**

Concealed Type



Suit wooden doors, frames etc. Magnet & Switch. Cat L-5212 **$4.95 Set**

Special Switch

Set for roller tilt doors. Cat L-5227 **$5.95**

Window Foil

An effective part of your alarm system – and also a visible deterrent.

32m roll adhesive foil. Cat L-5200 **$14.95 roll**

Foil terminal blocks. Cat L-5205 **$1 ea**

Pressure Mat

Hides under carpet: if it's walked on, it goes off. Put in doorway or hall for optimum protection. Cat L-5270 **$24.95**

Emergency Button

Just in case! Prowlers, peepers, snowdroppers ...one push of the button and it scares the daylights out of them! **$3.95** Cat L-5285

Heat Sensor

Why not make sure you don't burn down? Your alarm can look after that, too with this heat sensor! Triggers at 135 degrees F. Cat L-5254 **$17.95**

Horn Speaker

Economy Horn Speaker gives ear-piercing wail to almost wake the dead! Cat C-2705 **$13.95**

Horn Cover

With inbuilt tamper protection, stops them disabling your alarm speaker. CatL-5300 **$24.95**

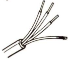
Strobe Lamp

Blue flashing light warns if your alarm has been triggered — even after the horn stops. Cat L-6000 **$39.95**

Connecting Cable

Various types to suit every application, 4 Core: Suits detection devices needing power or horn speakers with tamper protection, etc. Cat W-2100 **95¢ /m**

4 Core Phone Cable



Similar to above, but small diameter. Suits. permanent installation (not flexible). Cat W-2120 **75¢ /m**

Other types of cable: (Fig. 8, multi-core, etc always in stock).

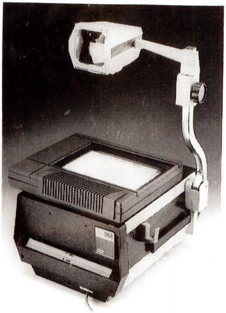
Gell-Cell Batteries

Rechargeable batteries for back-up use. Various sizes available (depending on capacity required) but general purpose 12V, 2.6Ah is ideal for L-5140 panel. Cat S-3320 **$38.95**

• **NSW** • **Albury** *21 8399* • **Bankstown Square** *707 4888* • **Blacktown** *671 7722* • **Bondi Junction** *387 1444* • **Campbelltown** *(046)27 2199* • **Chatswood Chase** *411 1955* • **Chullora** *642 8922* • **Gore Hill** *439 5311* • **Gosford** *25 0235* • **Hornsby** *477 6633* • **Liverpool** *600 9888* • **Maitland** *33 7866* • **Miranda** *525 2722* • **Newcastle** *61 1896* • **North Ryde** *88 3855* • **Parramatta** *689 2188* • **Penrith** *(047)32 3400* • **Railway Square** *211 3777* • **Sydney City** *267 9111* • **Tamworth** *66 1711* • **Warringah Mall** *905 0441* • **Wollongong** *28 3800* • **ACT** • **Fyshwick** *80 4944* • **VIC** • **Ballarat** *31 5433* • **Bendigo** *43 0388* • **Box Hill** *890 0699* • **Dandenong** *794 9377* • **East Brighton** *592 2366* • **Essendon** *379 7444* • **Footscray** *689 2055* • **Frankston** *783 9144* • **Geelong** *43 8804* • **Melbourne City** *326 6088* • **Richmond** *428 1614* • **Ringwood** *879 5338* • **Springvale** *547 0522* • **QLD** • **Brisbane City** *229 9377* • **Cairns** *311 515* • **Chermside** *359 6255* • **Redbank** *288 5599* • **Rockhampton** *27 9644* • **Southport** *32 9863* • **Toowoomba** *38 4300* • **Townsville** *72 5722* • **Underwood** *341 0844* • **SA** • **Adelaide City** *223 4122* • **Beverley** *347 1900* • **St. Marys** *277 8977* • **Elizabeth** *255 6099* • **Enfield** *260 6088* • **WA** • **Cannington** *451 8666* • **Fremantle** *335 9733* • **North Perth** *328 6944* • **Perth City** *481 3261* • **TAS** • **Hobart** *31 0800* • **NT** • **Stuart Park** *81 1977*

OR ORDER BY PHONE (TOLL FREE) 008 22 6610 FOR 24 HOUR FROM DSXpress – DELIVERED DIRECT TO YOUR DOOR.

New Products



LCD Projector

The days when a presenter has to labour over acetate sheets on an overhead projector (OHP) are numbered according to Hong Kong's International Quartz. The conventional use of overhead projectors will be superseded by a simple, uncluttered arrangement – a personal computer and an LCD PC projector; a visual display unit recently developed by International Quartz.

The device plugs into the video port of the computer through a DB9 connector, allowing the computer (with a CGA or EGA graphic presentation) to send pictures to the unit. The LCD device sits on the OHP, which in turn projects the image of the display onto a wall screen.

For further information, contact International Quartz, 24-26 Sze Shan Street, Yau Tong, Kowloon, Hong Kong, phone (852) 717 1391.

Strip connectors

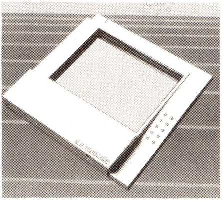
The Samtec line of screw machined lead socket and terminal strips and stamped socket and drawn wire terminal strips has been recently expanded with a number of new options.

The Australian distributors, Multi-Contact Australia Pty Ltd, advise that machined socket strips are now available with high temperature insulator bodies, low profile and high profile configurations, and a choice of lead diameter insertion sizes from .020″ diameter to .080″ diameter. Machined lead sockets can be supplied with "snap-strip" bodies or on a variety of carriers. Locking, surface mount and other special lead designs are available.

For further information contact Multi-Contact Australia, 53-55 Whiting St, Artarmon 2064, phone (02) 438 3600.

LCD projector

LCD projector panels are becoming popular as an adjunct to the popular OverHead Projector (OHP). These devices allow a computer to display an image on the viewer, which is in turn projected onto a wall screen. Several different types have been released recently, including a range from Electroboard. The most elaborate unit within the range is the PCV 4, which features one megabyte of memory and an infrared remote control.



Like the others within the range offered by this company, the PCV4 can be operated by by most computers, including the complete Apple range, most models of IBM computers, Atari, BBC and so on. Special deals are available to schools and the units cost from around $1500 (PCV1) to $4900 (PCV4). For further information contact Electroboard, 4th floor, 275 Alfred Street, North Sydney 2060, phone (02) 957 5842.

Low cost plastic FO cables

Universal Fibre Optics has available a wide range of low cost optical fibres and fibre-optic (FO) cables, suitable for applications such as lighting, display signs and short-haul optical communications. The company is also able to supply a range of low-loss silica fibres and cables, for longer-haul and more critical applications.

The PF-PG range of plastic optical fibres and cables are of the step-index type, with a core of high-purity polymethyl methacrylate and cladding of special fluorinated polymer. The PF series come in diameters from 0.5mm to 1mm, with an attenuation ranging from 0.14 - 0.18 dB/m at 650nm, a numerical aperture of 0.46 and a minimum allowable bending radius of 17mm. The PG series come in diameters from 0.25mm to 3.0mm, with attenuations ranging from 0.14dB/m for the smaller sizes to under 0.7dB/m for the largest sizes, again at 650nm. Numerical aperture for the PG series is 0.50, with a minimum bending radius of 9mm.

Both jacketed and unjacketed single fibres are available, in spools of up to 1000 metres, also jacketed multi-fibre light guide cables with up to 64 fibres, in spools with a length of 500m.

The silica fibres and cables are available in both step index and graded index types, the former with core diameters of 50, 60 and 100um and the latter of 50um. Jacket diameter is approximately 0.9mm, with the fibres available in 1000m lengths and the cable in 200m lengths. Loss figures for the fibres range from 3.0 - 5.0dB/km at 850nm, with the graded-index type having only 1.0dB/km at 1300nm. Bandwidth of the step-index fibres is 30MHz-km at 850nm, with the graded-index type ranging from 200 - 600MHz-km at 850nm and 400 - 800MHz-km at 1300nm.

Full technical and applications information for the fibres and cables is also available.

Further information is available from Universal Fibre Optics, 564 Glenhuntly Road, Elsternwick 3185 or phone (03) 523 5535.

SMT pick & place, solder systems

The Smart 2000 is a hot-gas system designed specifically for assembly, removal and replacement of surface-00001 mount components. Developed by the British firm Computer Recognition Systems Ltd, it is distributed in Australia by Royston Electronics.

At the heart of the Smart 2000 is the proven Packman X-Y-Z positioning table, which provides the required Pick-and-Place facilities. With the hot gas technique all components – including very small chips – can be mounted accurately on epoxy, ceramic and all other popular substrates.

Various other items of production equipment for surface mount technology are also available from Royston Electronics, including an inexpensive manually operated unit developed by the company in Australia to meet the needs of small volume manufacturers and service organisations. The company can also provide technical advice and guidance, based on its considerable experience with SMT.

Further information is available from Royston Electronics, 27 Normanby Road, Notting Hill 3168, phone (03) 543 5122, or at Unit 2, 28 Vore Street, Silverwater 2141, or phone (02) 647 1533.

Optical connectors

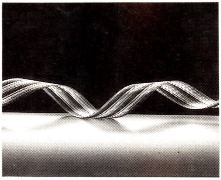
AT&T has announced the introduction of its new, low-cost, plastic STR II connector.

The STR II is the first product in a new family of Lightguide connectors that will be offered by AT&T primarily for data communications and other Local Area Network (LAN) applications. The connector is used to join fibre optic cables or to connect electronics into a data network.

It features enhanced hardware and a precision tip both moulded from engineering plastics. The enhanced hardware gives the connector reduced sensitivity to cable movement and improved repeatability, easier engagement and disengagement to couplings, and simplified field termination.

For further information contact AT&T, Westpac Plaza, 21st Level, 60 Margaret Street 2000, or phone (02) 221 3055.

Teflon ribbon cable

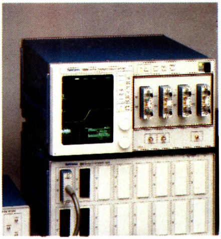


Belden Electronics has developed a new series of flat cable for use inside electronic chassis, and other high temperature applications.

The series 8R280XX .050″ pitch FEP rainbow flat cable is available with 10 to 64 28-AWG (7 x 36 stranding) silver plated copper conductors on .050″ centers. The operating temperature range is -40°C to 150°C; the voltage is 150V RMS.

Characteristic impedance for the series is 170 ohms when tested in the ground-signal mode, and 120 ohms when tested in the ground-signal-ground mode. Nominal capacitance at 1MHz is 7.5pF/ft (ground signal) and 10.5pF/ft (ground-signal-ground). The cable is rainbow colour-coded for easy circuit identification. The standard putup length is 100 feet.

For additional information contact Belden Electronics, PO Box 322, Clayton 3168 or phone (03) 240 0448.



20GHz digital sampling scope

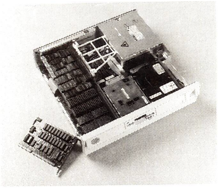
Tektronix has announced its 11800 series, a line of 20GHz digital sampling oscilloscopes with up to 136 channels, differential and single-ended Time Domain Reflectometry (TDR) measurements, and an easy-to-use comprehensive measurement system.

These high-performance instruments provide measurement stability and degrees of confidence for manufacturing and design engineers to quickly and easily develop, test and produce high-speed digital systems.

The 11800 mainframes and sampling heads are suited for design and automatic test of high-speed computer components and subassemblies, integrated circuits, such as ECL, GaAs and fast bipolar ASICs and VHSICs. Also digital telecommunication systems and equipment, including optical fibre and microwave transmission systems can be tested.

Tektronix 11800 series oscilloscopes include the 11801 eight-channel and the 11802 four-channel mainframes, the SM11 Multi-Channel unit, SD-24 Dual Channel TDR/Sampling Head, SD-26 Dual Channel Sampling Head, and the P6150 9GHz, passive probe.

For further information, contact Tektronix, 80 Waterloo Road, North Ryde 2113 or phone (02) 888 7066.



Memory expansion

Hypertec has announced it has some versatile solutions to memory limitations of the newly-announced IBM PS/2 model 30-286.

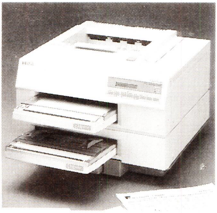
The 30-286 (the only AT-style machine now manufactured by IBM) comes standard with 512Kb of memory. IBM offers two upgrading options, to 1Mb using a further 512Kb, or to 4Mb by replacing the original 512Kb with 4 x 1Mb. The Hypertec alternative gives users a lot more flexibility of choice.

For the model 30-286 user who simply wants to bring system memory to the DOS limit of 640Kb, Hypertec offers the Hyper 128-16, which has a recommended retail price of $295.00 (ex tax).

For users who require not only the full complement of system memory but large amounts of expanded and/or extended memory as well, Hypertec is about to release Hyperam XT/AT, a memory board supplying between 2 and 8Mb of memory.

For further information contact Hypertec, 408 Victoria Road, Gladesville 2111 or phone (02) 816 1211.

New Products



New LaserJet

Hewlett-Packard Australia has announced the newest member of the HP LaserJet printer family: the HP LaserJet IID printer. HP has already sold more than one million HP LaserJet printers, making them the highest selling laser printers in the world.

The new printer complements the HP LaserJet Series II printer by providing twice the paper capacity (400 sheets) with two paper trays, duplex (two-sided) printing and a new accessory for automatically printing up to 50 envelopes. Each HP LaserJet IID printer also comes with 24 fonts.

The IID printer works with HP's Vectra PC, IBM and IBM-compatible PCs. Like the HP LaserJet Series II printer, the new printer works with all of the popular PC software packages, including Microsoft Word, Word Perfect and Multimate Advantage as well as the Microsoft Windows environment.

The printer comes with 640Kb of standard memory. The user can add on 1, 2 or 4Mb memory boards to expand this to 4.6Mb of memory.

The recommended retail price is $7500.00 (ex tax) and is available immediately through HP authorised dealers. The optional envelope feeder is $600 (ex tax).

For further information contact Hewlett Packard, 31-41 Joseph Street, Blackburn 3130 or phone (03) 895 2895.

Optical disk jukebox

Elmeasco has announced the availability of the Cygnet range of high performance optical disk jukeboxes and subsystems to enhance their Optimem range of 12″ format WORM drives.

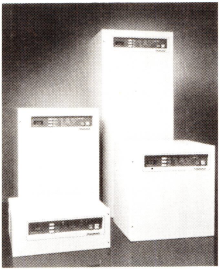
There are two series in the range. The first is the Cygnet 1800 series expandable jukebox, which is a robotic component of the 322Gb three module system. Either single sided or double sided 12″ optical disks can be used, to a maximum of 141 disks, which are transfered from their cartridges to the optical disk drive via the robotic system.

The second, the Cygnet 5000 series, uses 5.25″ disks.

Some of the features of both systems include extensive diagnostics, fast performance, and interfaces for RS-232C communications at 9600 baud.

Both the 1800 and 5000 series jukeboxes are compatible and both series will support most major manufacturers of optical drives available on the market today.

For further information contact Elmeasco, 18 Hilly Street, Mortlake 2137 or phone (02) 736 2888.



DC to AC inverter

The latest addition to the Topaz range of power conditioning products is the Topaz Powermark inverters.

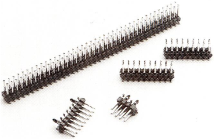
Ranging in sizes from 500VA to 15KVA, these inverters can be used whenever it is necessary to obtain stable, distortion free AC power from a DC source. They are ideal for applications in which sensitive electronic equipment must be operated in a location where commercial AC power is not available.

Using pulse width modulation technology, Topaz inverters ensure distortion free sine wave power for all types of loads. A 300% maximum current capacity eliminates the need for oversizing to meet load start-up surges, and digital system status monitoring provides clear, precise readings for all critical system power requirements.

All Topaz inverters feature INSTON, which combined with a 4 millisecond static bypass transfer switch, enables the inverters to be operated either in off-line or on-line mode. This feature gives added flexibility and protection against battery charger failure, battery failure or even inverter failure.

Topaz inverters provide excellent noise filtering, to prevent harmful noise transients corrupting sensitive equipment, even when the inverter is operating off-line. DC input voltages of 12V, 24V, 48V and 125V DC can be used with selectable outputs of 120V and 240V AC at 50 or 60Hz.

For further information contact On-line Control, Unit 2/7 Waltham Street, Artarmon 2064 or phone (02) 436 1313.



Surface mount connectors

The Molex 71308 series of connectors from Utilux is a dual row straight pin header manufactured with a break-away style housing which is also stackable side to side and end to end on unbroken edges for surface mount application. This allows maximum flexibility for the design of connectors.

The tin or selectively gold plated brass alloy pins are drawn from 0.64mm square wire which provies a four sided smooth interface and mates with female connectors on 2.54mm grid.

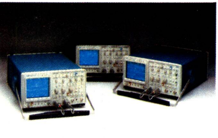
The 71395 series surface mount application vertical dual row PCB connectors are designed for parallel and perpendicular board stacking and for PCB to harness and PCB to chassis connections. These connectors mate with 2.54mm grid male connectors and have tin or selectively gold plated phosphor bronze terminals.

For further information contact Utilux, 14 Commercial Road, Kingsgrove 2204 or phone (02) 50 0155.

Portable digital scope

Tektronix has released the 2432A, which like the other members of its 2400 series of digital oscilloscopes, offers advanced built-in measurement automation and simplification features.

The 2432A joins the recently introduced 500 megasamples per second 300MHz 2440, and the 100 megasamples per second 100MHz 2430A in Tektronix's series of DSOs.



The 2432A like all Tektronix 2400 series digital scopes offers four key automation features: pushbutton scope setup even on an unknown signal, pushbutton measurement readouts, building and running of measurement sequences and pass/fail waveform testing using a limits envelope.

As well the 2432A allows full scope automation at the probe tip, eliminating the need to make all adjustments on the front panel. This feature delivers fingertip control of the scope, thus saving time and simplifying test and measurements.

For further information contact Textronix, 80 Waterloo Road, North Ryde 2113 or phone (02) 888 7066.

Hybrid TTL crystal oscillator

Hy-Q International have released their QX0-1000 series of crystal clock oscillators. This series is a combination of crystal technology and thick film hybrid integrated circuit processing and is available for microprocessor and computer applications.

The tiny packaged module greatly reduces the board space required by discrete component oscillators. It also minimises wasted time in sourcing suitable components.

The series is TTL compatible and can drive 10 standard TTL loads. The stability of the series is as high as +/-25ppm and can provide frequencies from 250kHz up to 80MHz.

If required, gold plated bases can be supplied, although the standard type base is suitable for most applications. The device is available in surface mount or conventional mount profiles, and comes in a package measuring 12.65 x 20.8mm.

For further information contact Hy-Q, 1 Rosella Street, Frankston 3199, or phone (03) 783 9611.

ROMS in C

Datalight has released a software package called C-thru-ROM, that allows programs written in the C language to be burnt into ROMs. The software runs with Microsoft C, and is a complete 8086 ROM development kit for use with Microsoft C 5.0 or 5.1 in the MS-DOS environment.

The program also includes a debugger that does away with the need for an emulator. It includes the tools to link a system for a non MS-DOS environment, to debug the application both on the development PC and on the actual target hardware, and lastly to locate it in target memory for burning ROMs.

It also includes a code locator called LOC, which allows the programmer to place code anywhere in 8086 memory. LOC is compatible with the Microsoft C compiler and linker.

For further information contact Microway, 292 Chesterville Road, Moorabbin, 3189, or phone (03) 555 4544.

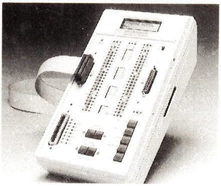
Multifunction tester

Datacom has released the DataTool 5000 multifunction communications tester, designed specifically for computer/data installations and maintenance personnel. The battery powered unit captures, displays and creates data via the RS-232-C serial or parallel interface ports.

The DataTool 5000 is easily set-up via internal menus to 'talk' to devices such as computers, terminals, printers, plotters, modems, line drivers, multiplexers and data communication links. It can even determine the configuration of interconnecting cables.

Functions provided by the unit include pin analysis, device analysis, bit stream analysis, event timing, data pulse signal levels, pulse detection and cable testing.

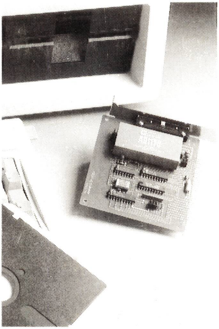
For further information contact Elmeasco, 18 Hilly Street, Mortlake 2137 or phone (02) 736 2888.



Low cost ADC card for PC compatibles

A new evaluation board for the Analog Devices AD1170, an 18-bit analog-to-digital converter (ADC), simplifies high-resolution data acquisition designs. System developers can plug the AC5004 board into any IBM PC/XT/AT (or compatible) and develop their hardware or software design.

The AC5004 includes a menu-driven demonstration program that exercises all 20 functions of the AD1170. One menu option turns the host computer into a 5-digit voltmeter.



The AD1170 is an intelligent ADC that supports 20 user-programmable commands via an on-board microprocessor. Users can program the device to perform a conversion in 1 to 350ms, at selectable resolutions from 7 to 18 bits. Its on-board micro also eliminates errors through an automatic calibration routine. Typical integral nonlinearity and span drift is +/−0.001% and +/−9ppm/°C, respectively.

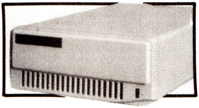
The AC5004 plugs into a short or long I/O slot of an IBM PC/XT/AT or compatible. Operation can be from the host computer's internal +/−12V supply or from an external power source. Available at $380.00 in single quantities, the board includes a software disk and user's guide. The AD1170 is purchased separately for $330.00 each. Both the AC5004 and AD1170 are available from Parameters, 25-27 Paul Street, North Ryde 2113, phone (02) 888 8777 or 1064 Centre Road, Oakleigh South 3167, phone (03) 575 0222.

E.A. GIVES YOU THE CHANC ELECTRONI

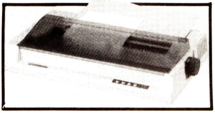
If you win you get to select betwee the unbelievable Tandy ELECTRONICS hi-fi pack

CHOOSE THE COMPUTER PACK WORTH OVER $6,400 AND THIS IS WHAT YOU'LL WIN!

HIGH PERFORMANCE TANDY 1000 TX. A PROFESSIONAL-CLASS MS-DOS COMPUTER FOR HOME, SCHOOL OR BUSINESS.
• Over six times faster than standard PC XT. • Built-in 8.89cm Disk Drive. Stores 720,000 characters. • Expandable with a second 8.89cm or 13.3cm Disk Drive. • 640,000 characters of memory. • IBM PC Compatible. • Includes MS-DOS 3.2 and GW-BASIC Software. • Includes Personal Desk Mate 2. **THE CM-11 HIGH-RESOLUTION RGB1 COLOUR MONITOR**, has a 33cm screen displaying 80 x 25 text, 640 x 200 graphics.



20-MEGABYTE HARD DISK CARD.
For the Tandy 1000, Tandy 3000 HL, IBM PC or PC compatible. Comes with manual and software utilities.



132 COLUMN BUSINESS PRINTER
A superior printer with exceptional speed and quality. Three modes for word processing, data processing and dot-addressable graphics.

PLUS

— Auto Dial Modem.
— All the necessary connection cables.

TO SUBSCRIBE

1 year subscription (12 issues) $45, 2 year subscription (24 issues) $88. Simply fill out the coupon attached and put it in the reply paid envelope suplied — if the coupon and envelope are missing, send your name, address, phone number and cheque, money order or credit card details (card type, card number, expiry date and signature) to Freepost No. 4, Electronics Australia Tandy Subs Offer, Federal Publishing Company, PO Box 227, Waterloo, NSW 2017. Any enquiries phone (02) 693-9515 or 693-9517. Unsigned orders cannot be accepted.

CONDITIONS OF ENTRY

1. The competition is open to Australian residents authorising a news renewal subscription before last mail February 28, 1989. Entries received after closing date will not be included. Employees of the Federal Publishing Company-Emona Instruments and their families are not eligible to enter. To be valid for drawing, subscription must be signed against a nominated valid credit card, or if paid by cheque, cleared by payment. 2. South Australian residents need not purchase a subscription to enter, but may enter only once by submitting their name, address and a hand-drawn facsimile of the subscription coupon to The Federal Publishing Company, PO Box 227, Waterloo, NSW 2017. 3. Prizes are not transferrable or exchangeable and may not be converted to cash. 4. The judges decision is final and no correspondence will be entered into. 5. Description of the competition and instructions on how to enter form a part of the competition conditions. 6. The competition commences on 28th November, 1988 and closes with last mail on February 28, 1989. The draw will take place in Sydney on March 3, 1989, and the winner will be notified by telephone and letter. The winner will also be announced in the Australian on March 7, 1989 and a letter of this magazine. 7. The prize is STA-2280 Receiver $999.95, CD-6000 $699.95, Mach-2 Speakers x 2 $1059.90, IMX Equalizer $299.95, Lab-801 Turntable $299.95, Vert. Utility cabinet $299.95, Hopz Utility cabinet $179.95, SCT-83 Tape deck $429.95, Univ. Remote control $199.95, Vid. Sound processor $199.95, Mini-7 speakers x 2 $279.90, OR 100TX Computer $2,299, CM-11 monitor $999, 20 meg. hard disc $999, DMP-440 Printer $1,299, 20 meg. hard RS-232 Cable $69.95. 8. The promoter is the Federal Publishing Company, 180 Bourke Road, Alexandria, NSW 2015. Permit No. TC88 0000 issued under the Lotteries and Art Unions Act 1901: Raffles and Bingo Permits Board Permit No. 880000 issued on 00.0.88 Act Permit No. TP88000 issued under the Lotteries Ordinance 1964.

TO ENTER THE DRAW SUBSCRIBE OR EXTEN

TO WIN IN THE ULTIMATE COMPETITION.

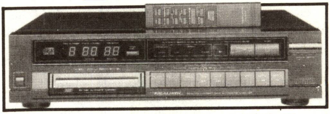
he fabulous Tandy ELECTRONICS computer pack or here can only be one winner!

CHOOSE THE HI-FI PACK WORTH OVER $6,400 AND YOU'LL WIN THESE 13 PRIZES

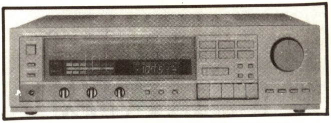
HIGH PRECISION FULL AUTOMATIC BELT DRIVE TURNTABLE.
This elegant slimline turntable gives you amazing clarity and superb sound. The belt drive system assures smooth rotation constantly and minimizes wow and flutter.

DELUXE 51cm COLOUR TELEVISION
• Infra-red remote control. • On screen display. • Sleep function. • The CTV-2001 has a slim line and sophisticated design.

PLUS
— A remote control VCR.
— A stereo cassette deck.
— 3-way bass reflex speakers with massive 380mm woofer.



COMPACT DISC — THE ULTIMATE IN STEREO-CD PLAYER WITH AUTO CHANGER
• With remote control for all major functions. • Plays up to 6 discs continuously. • 32 track memory. • Extended repeat mode. • Index search.

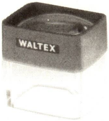


REALISTIC STA-2280, 100 WATTS PER CHANNEL, MINIMUM RMS INTO 8 OHMS FROM 20-20,000 Hz with more than 0.05% total harmonic distortion.
• 11-step bass, treble and balance controls. • Dual tape deck monitoring system. • Memory stores six FM and Six AM stations. • Easily expandable. • FM mute/MPX filter system. • Digital flourescent frequency display.

— Universal 8-in-one remote control unit.
— Sound processor with surround-sound.
— Equalizer with spectrum analyzer.
— Two minimums-7 mini-speakers.
— Two sturdy, attractive utility cabinets.

"HURRY OFFER ENDS 28th FEBRUARY, 1989"

PLUS EVERYONE WHO SUBSCRIBES OR EXTENDS THEIR CURRENT SUBSCRIPTION NOW RECEIVES THIS GREAT MAGNIFIER ABSOLUTELY FREE. THE WALTEX MAGNIFIER IS NOT A TOY. IT'S A LARGE HIGH MAGNIFICATION MAGNIFIER, WITH AN OPTICAL QUALITY ACRYLIC LENSE. IT'S IDEAL FOR VIEWING SMALL COMPONENTS, STAMP & COIN COLLECTIONS, JEWELLERY AND PHOTOGRAPHS.



OUR CURRENT SUBSCRIPTION BY 12 MONTHS.

PSPICE – low cost circuit simulator

PSPICE is essentially a training package for the mainframe circuit simulator and analyser program known as SPICE. Released by Prentice-Hall, this low cost package comprises two disks from MicroSim and a book that allows IBM PC or MAC users to get into computerised circuit design.

by PETER PHILLIPS

The idea of using a computer to 'dry run' a circuit is not new. During the mid 70's, the University of California, Berkeley, developed SPICE2, a derivative of SPICE, itself an evolution of CANCER – all of which are mainframe computer programs to provide circuit simulation. A circuit simulator allows a circuit to be 'entered' into a computer, for detailed analysis.

Because the university developed the software with public funds, their software is public domain, although the university provides no user support services as usually required by industry. Third party developers have since taken up the challenge and various versions of SPICE (Simulation Program with Integrated Circuit Emphasis) have emerged, making it the accepted standard in this field. Many versions are available, either for different computers or with different algorithms to support specific applications.

The version under review, called PSPICE (P for Personal computer) is from MicroSim, and is intended as a learning guide. Our copy was for an IBM PC (or compatible), but MicroSim also has a similar version for the Macintosh 2 computer.

There are other IBM PC versions of SPICE currently available, including AllSpice from Acotech, IS-SPICE from Intusoft, and Z-SPICE from Z-Tech. Many of these are very similar to the original SPICE2, but assume the user knows how to operate the program.

The package from Prentice-Hall includes a book written by Paul W. Tuinenga from MicroSim and the necessary software, contained on two 360K, 5.25" diskettes. The package has a recommended retail price of $31.95, although the book is separately available for around $23. There is no copyright on the disks – the screen notices even invite their distribution.

So, what is PSPICE all about? Here's what I found, after some considerable experimentation.

The software

Being curious and a mite impatient, I booted up the program (IBM version) without much prior reference to the book, and did not get very far. However, I figured out fairly quickly that a hard disk expedites things, although a BAT file to support twin floppies is included if a hard disk is not available. The IBM version of the software requires 512K of memory and provides support for various display devices, including the Hercules card fitted to my machine. I did not have to do anything to get into Hercules mode – it just happened.

My next step was to print out the README file, which runs to four pages. There are various printer graphic drivers within a file called PROBE.DEV, but text output does not require anything special.

The README file gave information on how to boot the program, and even some small references as to its use. A bit of random fiddling and further reference to the file told me that I could use the example circuit supplied with the program, as a means of seeing something. In fact, all that happens is a screen indication that the circuit is undergoing analysis.

The example took some 10 minutes on my AT (in turbo) to undergo complete analysis – it would take somewhat longer, no doubt, on an XT. Although not fitted to my machine, a maths coprocessor is stated as speeding things up by between 5 and 15 times.

It was time to get serious, as 'user friendly' is not the keyword here, so out with the book..

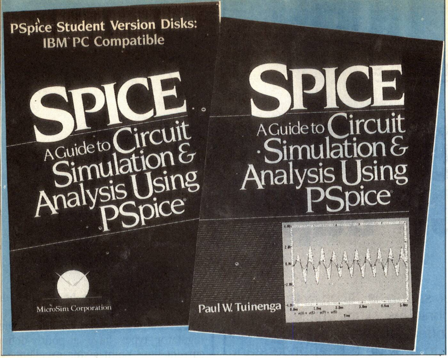
The book

The book, titled 'SPICE: A guide to circuit simulation and analysis using PSpice', is printed by Prentice Hall, and is a soft cover, 200 page presentation. The author, Paul W. Tuinenga is quoted as being from MicroSim, meaning the whole package is from MicroSim. The opening few pages give some history. The author then gets going from the first chapter by immediately inviting the reader to use the software. The writing style is friendly and uncomplicated, and not nearly as intimidating as one might expect with such a sophisticated application.

It became very clear after the first few pages that PSPICE is reasonably easy to use. The first chapter describes how to enter a circuit into the program, and following chapters build up to describe all the capabilities of the software. I found some of the descriptions too brief in some instances, and it took the README file to describe how I could get a graphics display of the frequency response of the test circuit.

The book is very complete, and there is little that could be regarded as superfluous in the text. An abridged summary of the PSPICE statements is included, along with a similar summary of the devices supported by the software. In general the book is relatively high power, as the package is for designers, and not really for beginners or hobbyists.

So after having read the book, it really remained to use the software.

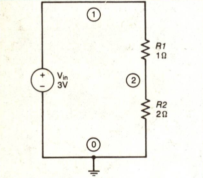

PSpice Student Version Disks:
IBM PC Compatible
SPICE
A Guide to Circuit Simulation & Analysis Using PSpice
MicroSim Corporation
SPICE
A Guide to Circuit Simulation & Analysis Using PSpice
Paul W. Tuinenga

Using PSPICE

The software assumes that all command entry will be with a text editor, and all information generated by PSPICE will be stored in an .OUT file to be read on a text editor. It took me some time to realise that Wordstar is not suitable as a text editor for PSPICE, and I finally resorted to XTREE PRO. In fact, this combination worked well.

Perhaps MicroSim could develop a text editor to go with the package – it would just round off an otherwise excellent presentation.

Having finally got past first base, I entered the first 'circuit' given in the book. Fig.1 shows the listing and the circuit, demonstrating the method. All components connect to nodes, numbered at will, although the reference must be called node 0. So there are no fancy graphics here – just text entry.



In PSpice, the circuit file to simulate this circuit is

```
* Resistor divider circuit
VIN 1 0 3.0volt
R1  1 2 1.0ohm
R2  2 0 2.0ohm
.END
```

Fig.1 The first example in the book, showing the circuit and the PSPICE file to describe it.

Once the 'circuit' has been saved as a file called [NAME].CIR, the PSPICE program is called up through the appropriate .BAT file. Before actually loading, it asks for an input file and an output file. The input file is the text listing of the circuit previously generated in the text editor and saved as .CIR file. This file can also contain commands on what the analysis parameters are, along with various other commands for PSPICE to act on.

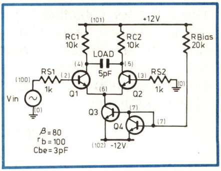
The output file is the file used by PSPICE to store the analysis results, and defaults to the input file name, with the extension .OUT.

The real power of the package is contained in the accompanying program called PROBE. If the input file contains the instruction .PROBE, usually at the end of the listing, after completing its analysis of the input file PSPICE will store the data in the .OUT file, generate a PROBE.DAT file, and automatically enter the Probe program. This allows the data to be viewed in graphical form according to the instructions keyed in while Probe is running.

To gain the best understanding of Probe, I decided to examine the example circuit, called EXAMPLE1.CIR. This 'circuit' is quoted as being a 'simple' differential pair transistor amplifier. I derived the circuit from the text listing and discovered it had a few twists, mainly in the form of a rather strange constant current source in the emitter circuit. However, because of the plentiful use of comments within the listing, I quickly figured out what was going on, including just what analysis the circuit was being put through. As recommended in the README file, I added the .PROBE instruction to the file, and let it rip.

After the 10 minutes of analysis time, I was greeted with the menu driven program called Probe, inviting me to examine the data graphically. It turns out the example circuit has a frequency response of 1MHz, even though PSPICE put it through a range of test frequencies from 1Hz to 10GHz!

It is possible to graphically display (and print out) almost every characteristic of the circuit, including transfer functions, phase response, group delay, even input and output impedance.



The circuit used in EXAMPLE1.CIR on the PSPICE disk. The circuit is put through almost every test.

Summary

Although it took me a bit of time to be actually up and running with PSPICE, my opinion is that this is an excellent package that should appeal to a wide range of people. Although PSPICE is a cut-down version of SPICE2, it retains most of the features, and allows circuits of up to 10 transistors. A disk file containing a library of devices is supplied, including an NPN and a PNP transistor, various diodes, power FETs and so on.

Let's be honest, this is a sophisticated bit of software, doing a complex task. One wonders how SPICE could be mastered without this package! It will find application in most educational institutions involved in the instruction of electronics, either as a tool or as a learning aid. Individuals should also find the package useful, as it is powerful program that allows computer simulation of a wide range of circuit designs.

However, because of its sophistication, the capabilities of PSPICE won't be learnt overnight. And that's what makes this package so good – useful software plus an excellent support manual.

The review copy was supplied by Prentice-Hall. The book is a 1988 edition ISBN 0-13-834607-0, 235 x 175mm, soft cover.

Power Supplies Feature:

Choosing a regulated DC power supply

The engineer selecting a power supply is faced with a bewildering choice of regulation techniques. This article, from an Australian manufacturer which offers all three techniques and combinations of them, attempts to provide a brief understanding of the principles of each type, and where they are most appropriately used.

by ROD TUSON
Statronics Power Supplies, Sydney.

LINEAR REGULATORS

Linear regulated DC power supplies are the best understood, because their principle of operation is the simplest. Essentially, a transformer operating at mains frequency provides isolation from the mains and reduces the voltage to an appropriate level. The low voltage secondary is then rectified and 'filtered'. The filtering is usually very minimal, and is there mainly to provide energy storage between the peaks of the AC waveform, so as to provide a minimum 'differential' voltage across the regulating element when the mains input is low and full load is applied. Ripple rejection is provided by the regulating element.

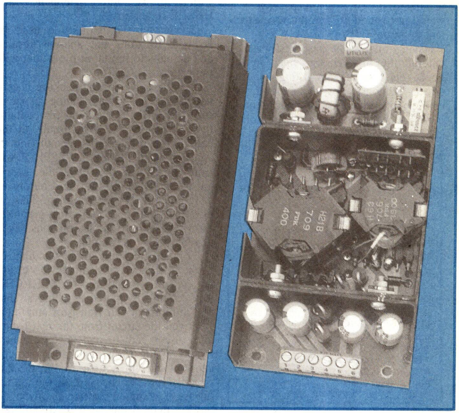
The 'linear regulator' is one or more semiconductor devices connected in series with the load, controlled in such a way as to provide constant voltage (or current) to the load terminals. The differential voltage between the rough input DC and regulated output, multiplied by the load current is dissipated in the device as *heat*. The device may be the ubiquitous 'three terminal regulator' or some quite complex circuit comprising precision references and operational amplifiers. Total band regulation from 1 or 2% all the way down to a few parts per million is possible with linears.

Advantages of linear power supplies are; very low ripple and noise (the lowest of this group of three), the best *load* regulation as a percentage for no load to full load. Excellent radiated noise (except in badly designed high power models).

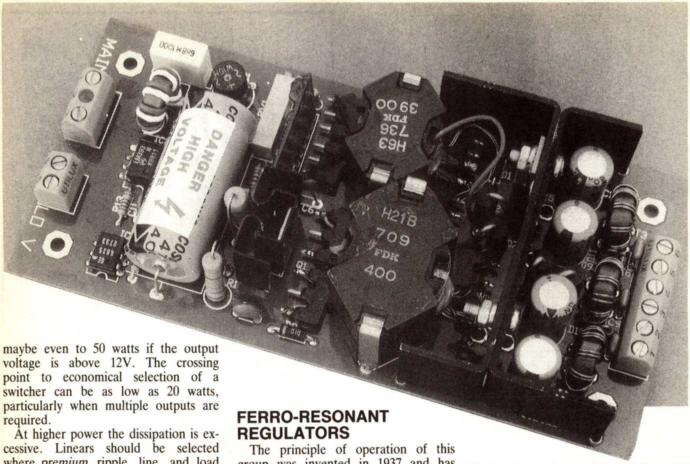
Disadvantages of linears are poor efficiency, particularly at low output voltages; very bad efficiency if wide input voltage changes are to be accommodated; and large size and weight for a given output power. Three-terminal regulator types have a poorly-defined current limit point giving excellent protection, but a wide tolerance. Because they generate a lot of waste power as heat, reasonably good ventilation must be provided, and they are a real problem in high ambient temperatures since the heatsinks necessary become huge.

Application of linears

Linears are an economic and technical proposition at very low output powers of a few watts to 20 or 30 watts,



The Statronics T40, a low profile 40W switch-mode DC/DC converter designed for telecommunications applications.



Statronics also makes this 40W switcher, the A40, which features three separate outputs and two-stage filtering.

maybe even to 50 watts if the output voltage is above 12V. The crossing point to economical selection of a switcher can be as low as 20 watts, particularly when multiple outputs are required.

At higher power the dissipation is excessive. Linears should be selected where *premium* ripple, line, and load regulation are mandatory. Don't be over-zealous about specifying these parameters however, because you may lock into a linear design which will cause thermal problems.

Precision analog circuits with error limits of 0.01% and less, should be powered by linears, unless there is built-in post-regulation. Good analog circuits of these types generally have at least 60dB power supply rejection, but switchers can introduce errors, particularly if not fully enclosed.

Linear regulators are quite often added after other power supply types to hold a portion of the output power to tighter limits. This is often a very good engineering option. For example, high power interfaces such as solenoid valves and the like, drawing several amps and large surges can be powered by a supply giving, say 5% regulation and a volt or two of ripple, (like a typical ferro resonant type), while some accurate analog circuit requiring just a couple of watts could be run from the same supply with a tiny 'on-board' linear regulator.

'Laboratory' power supplies (with metering and continuously variable output voltage and current limit) use linear regulation. Most also have some form of pre-regulation, ranging from automatic tap switching to switch-mode.

FERRO-RESONANT REGULATORS

The principle of operation of this group was invented in 1937 and has been in use ever since. The 'line conditioners' used to stabilise AC power and eliminate transients for micro-computers are based around the ferro-resonant principle, other wise known as the 'constant voltage transformer'. The regulation is accomplished entirely by the transformer, using saturation of one leg of the core as the non-dissipative regulating means.

In DC ferro-resonant power supplies (CVDC's), the output of the constant voltage transformer is left as a square wave. In AC CVT's the waveform is corrected to near sine-wave by a further resonance, then simply rectified and filtered. Schematically it looks like an unregulated supply with a weird transformer and an extra AC capacitor.

Advantages

Ferro-resonant supplies are simply the most indestructible power supply it is possible to build. They're the original 'bullet-proof' electrical and mechanical strength. Good modern designs are also very efficient. The transformer will be around 90% efficient at full load, and the rest of the losses are simply in rectifying, so for 24V and above, they are VERY efficient.

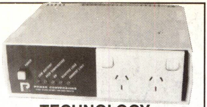
They have excellent surge capacity , can be run at overload for protracted periods and the better ones can stand a short-circuit load.

Wide excursions of line voltage cause no problems to the ferro-resonant power supply. While many may be specified for only +/−10% input, surges outside these limits can be tolerated without difficulty. With a little derating, very low input voltages to −25% will still provide acceptable performance. Very high line transients, even of long duration, are tolerated better than any other type of power supply.

While their ripple is fairly high, it is entirely predictable, and of a stable waveform containing only relatively low frequency components. Many loads have sufficient power supply rejection at these low frequencies to be untroubled by the ripple.

Disadvantages

They have fairly high ripple because no active ripple rejection is inherent in the design, filtering being typically provided by a large electrolytic capacitor. Three phase ferro supplies, on the other hand, offer greatly improved ripple performance over single phase models.



TECHNOLOGY BREAKTHROUGH

300 watt Sinewave Power Converter

After 7 years of research Power Conversions Pty. Ltd. proudly offers this Australian designed and built ultra lightweight sinewave 12VDC — 240VAC 50Hz, 300 watt inverter.
The power converter supplies quiet, reliable mains type power. Ideal for camping, caravanning, field maintenance, boating and for any remote area where mains power is unavailable. 240 VAC appliances can be operated from an ordinary 12 VDC car battery or similar, without encountering the problems of square and quasi-sine wave inverters.

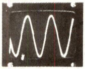
- WEIGHT ONLY 2.2 kg
- COMPACT — only 260mm × 220mm × 80mm
- LED display — monitoring battery, load and inverter conditions
- Twin power points
- PROVEN HIGH EFFICIENCY 80% typical, 82% peak, 70% at 10% load and less than 1.0 watt drain in autostart mode
- Guaranteed minimum 5% sine wave distortion, typically 3% when supplying resistive loads
- Stable 240 VAC sinewave output, ±5%
- Maintains total stability during large load step changes
- Designed to supply low power factor loads (±0.8)
- Simple to use — AUTOSTART — operates as a normal power point
- Short circuit proof/full current limiting
- Thermal overload cutout
- Battery reverse polarity protection
- Full output voltage protection
- Battery overvoltage and undervoltage protection
- Reactive power overload protection
- Transient suppression and protection
- NO FUSES required, interlocking relay lockout
- Product and energy consultation service from our qualified engineers free of charge to all our users
- Full documentation supplied
- ONE YEAR WARRANTY

BEWARE OF INFERIOR COPIES

PATENT PENDING

$495

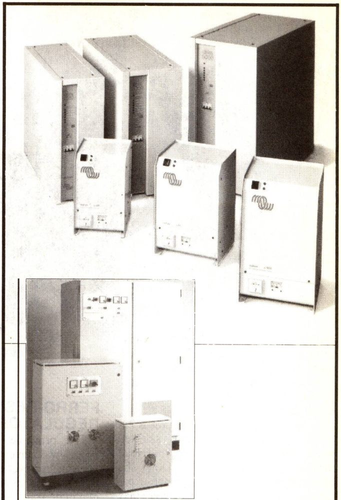
Standard model as reviewed in EA December '88



500 & 1200 watt units available on order

Distributor enquiries welcome

Power Conversions P/L
4 Chamouni Court
Frankston Vic 3199
Telephone: (03) 789 7354



FERGUSON TRANSFORMERS PTY. LTD.

THE TYREE VICTRON RANGE U.P.S. SYSTEMS

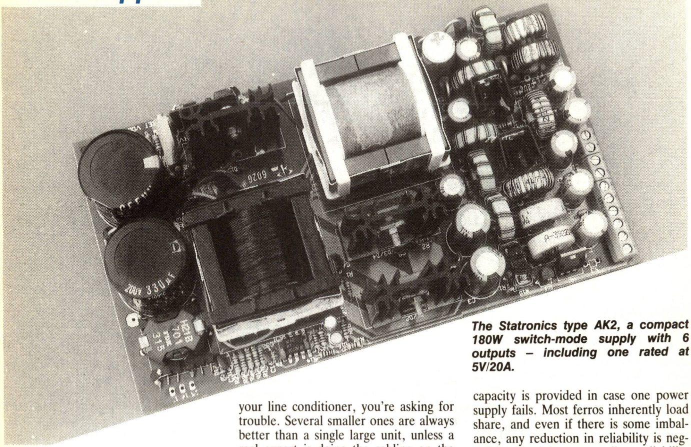
Here is a range of U.P.S. systems designed for today's microcomputers and other critical equipment which needs uninterrupted A.C. power.

The computer has become much more integrated in its environment; the impact of computer failure is not limited any more to a lost day in the financial department. Nowadays, a computer failure may interrupt a production process, totally disable a sales department, or ruin days of design work, the costs of failure being way above the investment in computer hardware.

The Tyree Victron range of U.P.S. systems overcomes these problems and is available to suit all applications and load requirements from 600W to 140,000W.

Complete specifications available on request from:

FERGUSON TRANSFORMERS PTY. LTD.
7 Moorebank Avenue, Moorebank, N.S.W. 2170.
Tel: (02) 602 1222 Fax: (02) 821 2027



The Statronics type AK2, a compact 180W switch-mode supply with 6 outputs – including one rated at 5V/20A.

The current limit point is dependent on the input voltage, which generally doesn't cause a problem in the kind of applications to which these supplies are put. Very importantly, the output voltage is dependent on line frequency. Clearly, the frequency stability of the national grid system is fine, but small emergency power sets and marine alternators have too poor a frequency control, and equipment exported to 60Hz locations must be fitted with the right model of supply.

The regulation, while reasonable for loads typically from 20% of fated output to 120%, is poor at light loads, Also, even though designed to run indefinitely at little or no load, at very light loads the saturable part of the transformer core is operating at high flux densities, which tends to generate heat.

All ferro-resonant transformers run best at higher loads, so when buying a line conditioner for your computer, don't over specify it. It's also unwise to connect a number of workstations to the same line conditioner. Switch-off transients from your work-mates connected to the same secondary won't be suppressed so well and could cause problems. If you run extension cords from your line conditioner, you're asking for trouble. Several smaller ones are always better than a single large unit, unless a real expert is doing the cabling on the load side.

Applications

Ferro supplies are great for battery charging where there is a 'standing' load, and are often used in un-interuptable DC power sources, (UPS). The generous overload margins are great to bring a battery back to charge quickly after a power failure. (It's important that the Ferro is not too over-sized for the battery, otherwise the maximum charge rate can be exceeded.) They are reliable enough to replace batteries in many applications, particularly if a large AC UPS is available.

They are also popular for powering large industrial PLC (Programmable Logic Controller) systems. Here the PLC can tolerate quite wide voltage swings but the consequences of any falling outside this wide band could be disastrous. So a ferro-resonant system cleans up all the horrible stuff the power authorities swear they never deliver, and the great surge capacity of the ferro looks after all the load surges taken by interfaces like solenoid valves, etc.

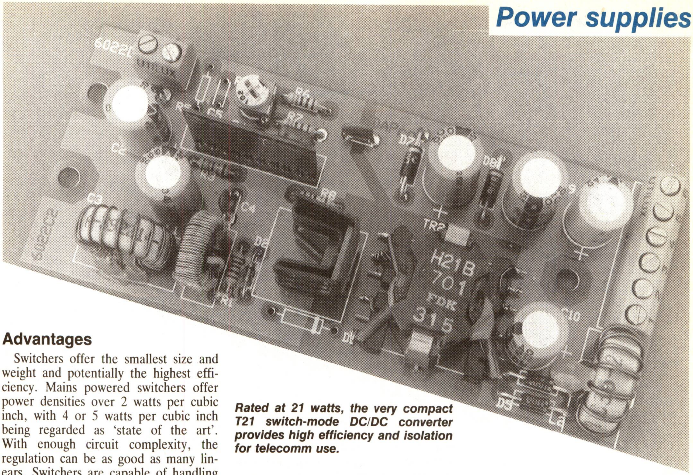
Ferro's are particularly friendly to 'redundant' power systems, where extra capacity is provided in case one power supply fails. Most ferros inherently load share, and even if there is some imbalance, any reduction in reliability is negligible. The inherent excellent reliability of the ferro contributes to the total system reliability.

SWITCHING REGULATORS & DC-DC CONVERTERS

Why are DC-DC converters grouped here? Because a switcher is simply a high isolation (input to output insulation and breakdown voltage) DC-DC converter with a rectifier and energy storage in front. In larger switchers there's also power factor correction. This is a huge topic, and has been covered in this journal before.

There are a number of 'topologies' (basic circuit principles), each with subgroups, and quite a large number of variants with wide patent protection. The common factor is that the input DC is switched on and off at an alarming rate (from 20kHz to as high as 30MHz, in some experimental work in the USA last year!). The duty cycle or (less commonly) the frequency of the switching is varied to control the output of the converter.

Because the switching element is always either fully *on* or fully *off*, the efficiency is typically quite high – in the case of some of the latest designs, as high as 90%.



Rated at 21 watts, the very compact T21 switch-mode DC/DC converter provides high efficiency and isolation for telecomm use.

Advantages

Switchers offer the smallest size and weight and potentially the highest efficiency. Mains powered switchers offer power densities over 2 watts per cubic inch, with 4 or 5 watts per cubic inch being regarded as 'state of the art'. With enough circuit complexity, the regulation can be as good as many linears. Switchers are capable of handling the widest input voltage range – input ranges over a 4 to 1 ratio are common, with efficiencies over 75%.

Many DC-DC converters are available with stunning efficiency and power densities. The absence of the input storage capacitor required for single phase off-line supplies means a big saving on space. Power densities from 4 or 5 watts per cubic inch, all the way to over 100 watts per cubic inch are now available from a number of vendors.

Of course, at 100W per cubic inch, an external heatsink is needed. There are some patented converters available from a small number of manufacturers which boast impressive efficiencies from 80 to 90%, with some un-regulated converters even topping 90%.

Disadvantages

Switchers have an ill-deserved reputation for poor reliability. This is largely caused by cost-cutting by the purchaser without thought to the consequences on reliability. There is no inherent reason why a switcher should be less reliable. One factor is that a 220V +/−10% rated supply can be damaged by our 240 +/−10% (some would argue +/−15/) power source. Unless the 220V switcher is designed with very generous safety margins, as the best quality imports are, they will come to grief on Australian mains.

They are susceptible to power line transients, unless special provision is made to deal with these. They also have a reputation for poor noise performance, particularly radiated noise. There are ways of containing their inherent noise, however. Many include enough filtering for most applications, while even the best may be unsuitable in high precision analog circuits. A degree of specialised expertise is required to handle this problem. Quite often, standard models include more filtering and features than are necessitated by the application, which of course, means extra unnecessary cost.

Applications

Obviously, all DC input applications require a 'switcher'. In AC applications the default selection should be a switcher, except where space and weight are no problem, the power is low, the input is not required to be 'universal', and the maximum ambient is not high. Under these conditions linear is a proposition. If exceptionally low output noise is required, and most of the above criteria apply, then again, a linear might be the easiest approach.

Above the low tens of watts, the choice should be limited to switchers or ferro-resonant. Ferros can be chosen only where weight and size is not critical, because ferro's are heavy. Also remember that they have high output ripple and are only suitable above about 100W.

Summary

Switching power supplies are the dominant method of handling electrical power conversion. A few years ago, they were only considered to be a proposition where multiple output voltages were required, and there the total power was above about 60 watts. This has all changed. A mains input 'off-line' switcher is now practical for even 5 watts and triple output, and they are made up to 10kW output. At low power levels, the use of *universal input* switchers presents special advantages to equipment exporters.

Despite this, there are still many applications where either a ferro-resonant or linear power supply is the very best selection, and they should not be overlooked.

AUSTRALIAN MADE

Statronics are your one-stop source for DC Power Supplies and Converters

AUSTRALIAN MADE

Linear Regulated DC Supplies - 53 Series

- Low Ripple and Noise
- Current Limited
- Over-Temperature Protected
- Over-Voltage Protected (53/3 & /5)
- Modular, Bench or Panel Mounted
- Wide Adjustment Range
- Good Regulation
- Fully Floating Outputs
- Series or Parallel Operation
- Suitable for Battery Charging
- Fully Approved
- Proven Reliability
- 240V+10% Input, 45-60Hz
- 110/115V also available

Single Output

Adjustable Voltage Range	*Maximum Current (cont)*	*Model Number*
2 to 3	2	53/5
4 to 6	2.5	
6 to 11	2	53/3
12 to 15	2.5	
16 to 18	1	
16 to 23	0.7	53/2
22 to 26	2.5	53/4
24 to 30	1	53/2
31 to 34	0.5	
35 to 43	0.4	53/7
44 to 52	0.6	
53 to 60	0.4	

Dual Output

Adjustable Voltage Range	*Maximum Current (cont)*	*Model Number*
±2 to ±11	0.7	53/2
±4 to ±6	1	
±12 to ±15	1	
±15 to ±17	0.7	
±18 to ±30	0.5	53/7

Triple Output - Model 53/6
(Total output power 25W)

Output 1 5V (Fixed) 2.5A max (cont)
3A surge
Outputs 2&3 as 53/2 Dual Output above

Heavy Duty Ferro-Resonant DC Power Supplies - FE Series

- Ideal for Industrial Applications
- Fully spec'd for ±15% Mains Varia'n
- Up to 85% Efficiency
- Short Circuit Proof
- Low Ripple & Good Regulation
- No Switching Transients or RFI
- Cool Running
- 28V and 13.8V Models Ideal for Float Charging Lead Acid Batteries
- Series or Parallel Operation

Single Output

Model Number	*Input Voltage (50Hz)*	*Output Voltage*	*Nominal Load (Amps)*
FE1	240±15%	24	5
FE2	240±15%	28	4.5
FE3	110±15%	24	5
FE4	110±15%	28	4.5
FE5	240±15%	13.8	10
FE8	240±15%	48	4
FER39	240±15%	24	7
FER44	240±15%	28	6

Triple Models

Model Number	*Input Voltage (50Hz)*	*Output Voltage*	*Nominal Load (Amps)*
FER339	240 or 3ph star	24	21
FER344	240 or 3ph star	28	18
FER306	240 or 3ph star	48	12
FER3R as 339/344 - 2+1 redundant		24 / 28*	350W
FER3RM as FER3R with alarms		24 / 28*	350W

* Specify when ordering

Triple Models incorporate 3 matched supplies on a single chassis with outputs paralleled or in series (to special order). Input can be single phase or 3-phase with neutral.

Switched Mode Power Supplies and DC-DC Converters

- Very High Efficiency
- Super Compact
- 3,750Vrms Isolation
- Single & Multiple Outputs
- Low Ripple
- Input Under-Voltage Lock-Out
- Soft Start
- Current Mode Control
- Overload Protected for Indefinite Short

AC or DC INPUT SUPPLIES OUTPUT	5V, 12V, 12V							5V, 15V, 15V		15V, 15V		12V	5V, ±12, 15, 24V
MODEL NUMBER	X08T1212	A10T1212	X10T1212	A20T1212	X20T1212	A30T1212	A70T1212	X20T1515	A20T1515	A20D1515	U30D1515	A70S0012	AK2F2415
Input Voltage Range (Vac rms)	95-280	200-280	90-280	200-280	90-280	200-280	200-280	90-280	200-280	200-280	90-140	200-280	200-280
or DC Input Voltage Range (Vdc)	90-400	180-400	90-400	180-400	80-400	180-400	180-400	80-400	180-400	180-400	80-200	180-400	180-400
Max Total Output Power (W)	7.5	10	10	20	20	30	70	20	20	20	30	70	150
5V Output *Min Load* (A)	0.2	0.3	0.3	0.6	0.2	1	1	0.2	0.6	-	-	-	3
Max Cont Output (A)	1	1	1	2	3	3	7	3	2	-	-	-	18
Other Outputs (Vdc)	12+12	12+12	12+12	12+12	12+12	12+12	12+12	15+15	15+15	15+15	15+15	12	±12+15+24
Min Load (A each)	0.05	0.05	0.05	0.05	0.05	0.05	0.1	0.04	0.04	0.05	0.07	0.4	0.2
Max Cont Output (A each)	0.2	0.25	0.25	0.5	0.5	0.8	0.8	0.4	0.4	0.5	1	5	1 to 5

DC-DC CONVERTERS OUTPUT	5V, 12V 12V					15V, 15V	5V, 15V, 15V	24, 24V	12V	24V	40V	250V	
MODEL NUMBER	T10T1212	T20T1212	T30T1212	T70T1212	R07T1212	T10D1515	T30T1515	T70D2424	T60S0012	T70S0024	R70S0040	BK1S250Z	IK2S250Z
DC Input Voltage Range (Vdc)	21-63	21-63	21-63	21-63	90-150	21-63	21-63	21-63	21-63	21-63	90-150	12nom	24nom
Max Total Output Power (W)	10	20	30	70	7	10	30	70	60	70	70	100	200
5V Output *Min Load*(A)	0.3	0.6	1	1	0.2	-	1	-	-	-	-	-	-
Max Cont Output (A)	1	2	3	7	1	-	4	-	-	-	-	-	-
Other Outputs (Vdc)	12+12	12+12	12+12	12+12	12+12	15+15	15+15	24+24	12	24	40	250	250
Min Load (A each)	0.05	0.05	0.05	0.1	0.04	0.04	0.04	0.1	0.4	0.25	0.15	0.04	0.05
Max Cont Output (A each)	0.25	0.5	0.8	0.8	0.25	0.35	0.8	1	4	2.5	1.5	0.4	0.8

All Products Carry A Five (5) Year Warranty, Parts And Labour

For further information, prices, application assistance or custom design contact

STATRONICS POWER SUPPLIES

103 Hunter Street, Hornsby N.S.W. 2077 Tel : (02) 476 5714, 477 5011, Fax (02) 476 6914

Power Supplies

News & Products

International interest in local DC-DC converter

It seems our story printed in *EA* February 88 (page 96) concerning a development by Statronics Power Supplies has reached the four corners of the globe. The story reported a new technique developed by Statronics, that enabled the development of a remarkably efficient and compact DC-DC converter.

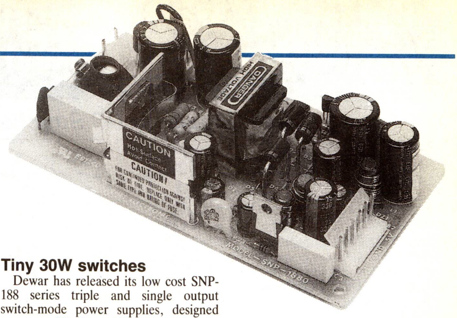
The feature of the converter is a zero-voltage switching method which ensures that switching losses are eliminated for ALL load conditions. International patents are currently being established through the patent co-operation treaty in a large number of countries.

The performance of the converter, as detailed in the previous article is quite incredible. It can deliver 10 amps at 5V DC output with 90% efficiency, and is contained in a package not much larger than a 40-pin IC. The unit is designed to convert 40V DC to the required 5V DC.

This means the 40V supply, developed with conventional switching regulators, can be distributed around a mainframe computer as an ELV (extra low voltage) supply. By fitting the Statronics 5V regulators as required, sections needing 5V can be supplied without the usual hassles of massive bus bars and other problems.

With all these advantages, it is perhaps not surprising that Statronics has been besieged with expressions of interest from most of the leading mainframe computer manufacturers. It seems our article was noticed by a surprising number of overseas research departments with 'watching briefs' on power supply developments. Statronics report that important enquiries have been coming from USA, Europe and Japan.

We are certainly chuffed at having helped a local development get international recognition, but the real credit obviously goes to Statronics.



Tiny 30W switches

Dewar has released its low cost SNP-188 series triple and single output switch-mode power supplies, designed to meet UL478, 1012, CSA22.2 and VDE0806 safety standards. All models have overvoltage crowbar protection on output 1, current limiting overload protection is standard on post regulator outputs and power foldback protection on all outputs.

This series of powe1 supplies feature a special flyback circuit design, which allows delivery of 30 watts of power from a circuit board measuring only 130mm x 70mm x 33mm. High reliability is assured and all models feature soft start circuitry to limit inrush current and eliminate turn on overshoot.

All units undergo 100% hi-pot and 100% cyclic burn in. They are built to meet AS3260-1988 Safety of Information Technology Equipment.

Voltage outputs available range from 5 volts to 24 volts single or multirail and efficiency is greater than 70%.

For further information contact Dewar Electronics, PO Box 49, East Ringwood 3135 or phone (03) 725 3333.

High voltage DC supplies

High voltage power supplies are often hard to find, and a range of units manufactured by Stanford Research Systems could well fill the gap.

Three models are available: the PS310, PS325 and the PS350, which give voltages of 1.25kV, 2.5kV and 5kV respectively. All three models have a 25W power rating and offer a line regulation of 0.001% for a 10% variation in the supply voltage. Ripple is less than 0.002% of full scale.

Two 4-digit displays give continuous readout of current and voltage, while a third displays the parameter being entered. Hard and soft current limits may be set and the units are arc and short circuit protected. Output voltage may be set to 1 volt resolution.

Connectors are provided for remote voltage setting/ramping, and for current and voltage monitoring (0 to +10V). Up to ten instrument settings may be stored and recalled. An optional GPIB port allows programming of input settings and reading of outputs and instrument status.

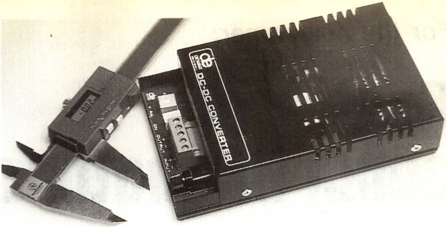
For further information, contact Scientific Devices, 2 Jacks Road, South Oakleigh, 3167 or phone (03) 579 3622.

Unitech buys Veeco

In a move intended to strengthen its worldwide manufacturing base, Unitech has announced plans to acquire Veeco Instruments, a leading multi-national manufacturer of power supplies and electronic instruments. The tender offered by Unitech is around $US327 million.

The acquisition of Veeco will give Unitech control over US based Lambda Electronics, the world's largest supplier of switching and linear power supplies to the commercial, industrial and defence markets. Veeco also owns 72% of Japanese subsidiary NEMIC-Lambda, a manufacturer of a full range of power supply products for the Japanese and Far Eastern markets.

3-rail DC-DC converters



Designed to meet Telecom Spec 974 requirements, these 3 rail DC-DC converters are input/output isolated to 3500V RMS at 50Hz.

The model 877 features 5 volts at 1.8 amps and the +12V and −12V outputs are 0.4 amps. Output ripple and noise is better than 20mV p-p on all rails, while line and load regulation is less than 1% on the 5V and better than 5% on the +/−12V rails.

All outputs are adjustable and are protected against short circuits. Overload LED's indicate the status of the 5 volt rail. The input allows a DC range of 21V - 65V DC and is fuse protected. Operating temperature range is from 0°C to 50°C.

Fully designed and assembled in Australia, these supplies are ideally suited for telecommunication and associated applications.

For further details contact Dewar Electronics, PO Box 49, Ringwood East 3135 or phone (03) 725 3333.

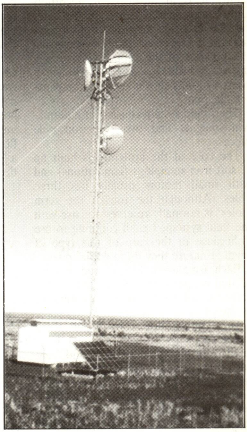
Statronics update

Statronics Power Supplies moved in December to larger premises at 26 Leighton Place, Hornsby. Telephone and fax numbers are the same as for the previous address. The new premises are three times larger than the previous address, and should enable the company to handle the increase in export activities it is currently experiencing.

The company has also announced its first full-range catalog. The catalog features 50 pages of information, including useful information for power supply users. The catalog includes details of the company's range of linear, ferro-resonant and switch mode power supplies, as well as information on its DC-DC converters.

Statronics has also introduced a new service for customised design and manufacture of power supplies. The new design can be based on existing Statronic products, or can be a completely new design. The proprietary zero-voltage switching technique described elsewhere in this column is available as a design option as are many other established Statronics designs.

For further information contact Statronics Power Supplies, 26 Leighton Place, Hornsby, 2077 or phone (02) 476 5714.



SOLAREX

AUSTRALIAN MADE

WHERE

Site accessability is difficult

Occasional maintenance is expensive

System reliability is important

A Solarex photovoltaic power supply can rescue you from the expenses and worries of unscheduled maintenance requirements. Solarex power supplies are in continual service on every continent, and on hundreds of islands, throughout the world. From critical health care systems in the jungles of South America — to radio relay systems on the Himalayas — to solar water pumping systems in the Australian outback — Solarex has been there.
Call Solarex — the most experienced designer and manufacturer in the world.

SOLAREX PTY. LIMITED
78 Biloela Street, Villawood 2163
P.O. Box 204, Chester Hill 2162
Tel: (02) 727-4455. FAX: (02) 727-7447
Telex: AA121975

Other States: (09) 344 4000 (089) 81 5411 (07) 252 7600
(08) 272 8536 (03) 596 1974

For the newcomer:

Basics of small DC motors

Although newer types of motors with electronic commutation systems are gradually replacing the conventional type, the latter are still by far the most widely used in common appliances and tools. Here's an easy to understand introduction to the way they work.

by J. EMERY

Conventional DC motors may be classified according to their field systems, the simplest of which uses a permanent magnet. They can usually (but not always) be identified by the fact that they have a wound armature and a commutator with brushes.

Permanent magnet type

These are small in size and are commonly used in tape/cassette recorders and battery operated toys. In the latter case the fact that their direction of rotation can be reversed simply by reversing the polarity of the supply voltage is a distinct advantage. Their principle of construction is shown in the accompanying diagram.

Their field system consists of a permanent magnet and two soft iron pole pieces.

The core of the armature is built up of soft iron stampings (laminations) and with small motors usually has three poles. Although the use of the term 'poles' is normally reserved for use with the field system, I shall continue to use it because in the case of this type of small armature they do look like poles.

Each armature pole is wound with insulated copper wire and the ends of the coils are connected to the commutator as shown.

The commutator consists of three metal segments (usually copper) insulated from the spindle (shaft) and from each other. Its purpose is to act as a rotary switch, ensuring that the current is always fed to each of the three armature coils in the correct direction to keep the armature turning continuously in the required direction.

Two carbon or graphite brushes are used to feed the current into and out of the commutator, as the armature rotates.

Using conventional current flow and the 'right hand rule' for electromagnets, it will be seen that the two upper armature poles in the diagram will be North poles and the lower one a South pole. Because like poles repel and unlike poles attract, each of these poles will react with its adjacent field pole, causing the armature to rotate in a clockwise direction.

The lower armature pole will be repelled by the South field pole and attracted to the North field pole. When it passes the centre of the North field pole however, the new position of the commutator will have reversed the current flow through its winding, changing it to a North pole. It will then be repelled by the North field pole and continue to cause the armature to rotate in a clockwise direction.

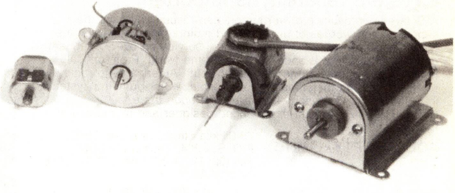
Because a DC motor and a DC generator are similar, an EMF (called a 'Back EMF' because it opposes the supply voltage) will be generated in the armature. The speed of the motor will rise until this back EMF approaches the value of the supply voltage. When a load is applied to the motor, its speed will drop and the back EMF will fall, allowing more current to flow. This produces more torque, to allow the motor to cope with the load.

When a DC motor is first switched on, it will draw a heavy current because there is no back EMF to help limit the current drawn from the supply.

The Permanent Magnet motor is regarded as a 'constant speed' machine, but because of its small size and large losses it falls short of this ideal.

Except in the smaller sizes, the armatures of most DC motors have more than three coils and armature segments, but the principle of operation remains the same.

Larger DC motors usually have wound (electromagnet) field systems. These field pole windings may be connected in series or parallel with the armature.



A selection of small conventional DC motors, of the type still used in many small tape recorders, printers and toys.

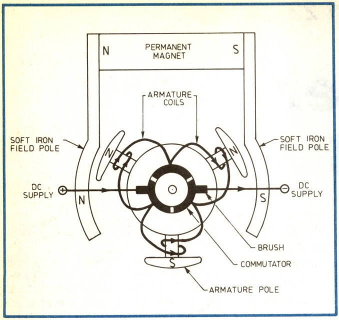


Fig.1: Basic structure of the simplest type of DC motor, with a permanent-magnet field and an armature with three salient poles.

Shunt motors

In these machines the field pole windings are connected in parallel with the armature and have a large number of turns of fine gauge wire and a high resistance.

Like the permanent magnet type they are regarded as constant speed machines, although their speed does fall as the load is applied.

To reverse the direction of rotation of a shunt motor, it is necessary to reverse the electrical connections to *either* the field windings or the commutator – not both. Simply reversing the polarity of the electrical supply to the motor (which is the same as reversing the connections to both) leaves the same relationship between the field and armature, so the motor continues to rotate in the same direction as before.

Note also that if the field winding becomes disconnected from the power supply when the motor is running, with the commutator still connected, the motor will try to *increase* its speed. This is because with a weaker magnetic field around the armature, it will have a lower back EMF. The current will therefore rise, and the motor speed will increase in an attempt to match the back EMF with the supply voltage and reach a new equilibrium. If the motor is not loaded, it can speed up so much that the armature will fly apart.

Series motors

Because the field pole windings of these machines are connected in series with the armature, they have fewer turns of much heavier gauge wire and a low resistance. The series connection gives this type of DC motor special characteristics, which can often be very useful.

When the load is applied they slow down and the current in both the field and the armature increases. If the current doubles then the (magnetic) strength of both the field and the armature will double giving four times the torque to carry the increased load. There is however a price to be paid, and this is that the speed will fall to half.

The effect is not unlike changing to a lower gear in a car – which in many cases is a decided advantage, particularly in traction work. For this reason early electric vehicles such as trams connected their motors in 'series mode' for starting, and then switched over to 'shunt mode' for running at speed.

Conversely, if the load is removed a series motor tends to over speed. In the case of small hand held equipment such as electric drills and food mixers they are prevented from over-speeding by the friction in the gearing and the good sense of the operator.

Note that because the field and armature windings of a series motor carry the same current, the motor's direction of rotation again can't be changed merely by reversing its connections to the power supply. It is necessary to reverse the connections of the field windings and commutator, relative to each other.

In passing, it should also be noted that with both shunt and series motors, the performance may not be the same in both directions of rotation. This is because when a motor is operating, there is a 'reaction' between the magnetic fields produced by the field and the armature, which effectively skews the field. To optimise the motor's operation for one direction of rotation, the manufacturer may set the axis of the brushes at an angle to counteract this skewing. As a result, its performance may become quite poor if you try to operate it in the reverse direction.

Compound motors

The speed regulation of a shunt motor can be improved by adding a set of series-connected field windings, in addition to the main shunt connected field. This is generally only done with larger DC motors. A motor with these additional series field windings is known as a 'compound' motor.

In a typical compound motor the magnetic field produced by the series field windings is arranged to be in the *opposite direction* to that of the shunt field, to reduce the magnetic field as the motor draws more current – and hence force it to increase its speed, to maintain the same back EMF.

By careful adjustment of the number of turns in the series field windings, the motor's speed regulation under load can be improved significantly, compared with a simple shunt or series motor.

'Universal' motors

Given small size and suitable design, a series motor can be adapted to run on either AC or DC. Since the field coils and armature windings carry the same current, the polarity reversals of AC have no effect on the direction of rotation. The main difference is that when running on AC the motor will deliver its torque in small pulses at a frequency of 100Hz, rather than continuously.

For a 'universal' AC/DC motor the field system as well as the armature should be of laminated iron, to reduce eddy currents. In the design of the magnetic circuit allowance must also be made for the fact that a supply of 240 volts RMS has a peak value of 340 volts.

Brush sparking on AC will usually be greater than on DC, because at the time each armature coil is shorted in turn by the brushes, that coil will have an EMF induced in it by the field poles – due to transformer action.

As with all commutator machines the correct grade of brush material is important if sparking and commutator wear are to be kept to a minimum. Flexible copper pigtails are often fitted to the brushes, to ensure a good electrical contact between the brush and the brush-holder.

An introduction to hifi - Part 22

Loudspeaker Systems - 3

This chapter begins with an explanation of nominal loudspeaker phasing, its subjective effects and how it can be checked. Attention then turns to frequency dependent phase shift and its claimed role in the reproduction of transients. Finally, the acoustic centre of typical drivers is discussed along with the argument for 'time' alignment.

by NEVILLE WILLIAMS

As already indicated, a hifi loudspeaker system should ideally be capable of reproducing all the frequency components in a program signal in their correct relative amplitudes, and free from distortion in the form of spurious additional resultants.

As well, the high, mid and low frequency spectral components in a complex signal should ideally reach the listener in the same time order and phase relationship as originally recorded. If they do not, the loudspeakers, or the system as a whole, may be open to challenge on the grounds of differential phase shift and/or (in engineering jargon) 'distortion in the time domain'.

At a basic level, it is normal practice to connect all drivers in a multi-speaker system, whether mono or stereo, so that they will operate – at least nominally – in phase. Essentially, this means that, if fed with (say) a positive-going step signal, all cones will be displaced in the same direction.

To facilitate system wiring, it is usual to mark the loudspeaker voice coil (or other input) terminals with '+' and '-' signs or to colour-code them red and black.

The convention is that if (say) a 1.5V cell is touched in that polarity across the voice coil terminals, the cone will move forward (i.e., outwards into the listening area). The displacement is fairly obvious with bass drivers and most squawkers, but is often difficult to judge with tweeters. Fortunately, however, their polarity coding can usually be taken for granted. (See Fig.1)

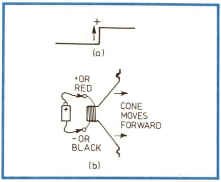


Fig.1: A positive-going step function signal (a). The polarity and marking conventions for most moving coil speakers are shown in (b).

Audible phase effects

The sonic effect of loudspeakers operating in or out of phase is usually most apparent to a listener when it involves two parallel connected bass-end drivers mounted on the one baffle or in the one enclosure.

Operating (correctly) in phase, adjacent bass drivers assist each other in creating successive half-cycles of high and low air pressure in front of the enclosure, which then radiate outwards across the listening area as low frequency sound waves.

By contrast, with the cones operating (incorrectly) out of phase, air pressurised by either one, tends to move into the rarified zone being created simultaneously by the other, a situation commonly described as an 'acoustic short circuit' (see chapter 20). Propagation into the listening area is thereby diminished, resulting in a noticeable loss of bass response.

As it happens, multiple (or parallel connected) low-end drivers are not very common in domestic hifi enclosures but, because the acoustic short circuit effect can be evident up to at least 1kHz (chapter 20), residual phase interaction can occur between a woofer and an adjacent squawker over the region from a few hundred hertz to something above 1kHz.

Reversing the signal feed to the squawker may therefore have an audible effect on mid-range tonal balance. While in-phase operation is regarded as normal and correct, the writer has known cases where a deliberate out-of-phase connection has been suggested by a system designer to render the mid-range less prominent.

By contrast, reversing the feed to a high-range tweeter may have little or no discernable effect on the sound as heard, although it would almost certainly show up under anechoic test conditions.

Checking stereo phase

In a stereo system, it is again normal practice to arrange for all drivers to operate (nominally) in phase, for two main reasons:

1. Even though physically separated, the woofers can still assist one another in progagating low frequency sound throughout the listening area, and
2. Balanced, in-phase mid-frequency signal components are considered by most designers to have a role in establishing firm centre-stage sound images.

A practical application of the above is illustrated in Fig.2, which depicts a simple method of checking the relative phase of a pair of stereo loudspeaker systems. Place them virtually face to face and carefully note the sound level

Technics' flat honeycomb-disc drivers align the acoustic centres with the front face of the enclosure, minimising phase differences.

and balance at normal listening distance, when playing a mono signal (preferably) or a stereo signal with plenty of bass in both channels.

Then, leaving everything else as is, reverse the connections to one system only and listen to the same passage again. The correct connection is the one which gives a full-bodied middle and low response. By comparison, an out-of-phase connection gives an 'empty' sound, because the woofers and squawkers are primarily shuffling air back and forth between the two systems – a further example of an 'acoustic short circuit'!

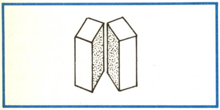


Fig.2: The phasing of a stereo pair of speakers can be checked using a mono reference signal and listening to the sound while reversing one set of leads only (see text).

The foregoing discussion has mainly to do with the physical wiring to the drivers – a relatively simple matter, which usually can be checked by inspection.

A more complex problem arises from the fact that individual frequency components in a typical signal may be subject to elusive and substantial phase shifts in any or all of the following:

- The original signal source – tape, disc, broadcast, etc.
- The entire reproduction chain up to and including the amplifier;
- The cables and frequency divider components feeding the individual drivers;
- The acoustic path from the voice coils to the listening position.

In the listening room itself, for example, frequencies above a few hundred hertz are projected more or less independently from the individual stereo drivers, being thereafter reflected from adjacent surfaces, adding and cancelling in space in a seemingly random manner.

The wonder of it is that our ears can sort out the constantly changing sonic jig-saw as well as they do, pinpointing the reconstituted sound source and interpreting the spatial echoes.

Most agree that the relative phase of the individual components contributes to that ability. Where some have disagreed is on the question of whether phase is critical, or a merely contributory factor.

Until about the mid '70s, hifi industry emphasis was on obtaining the flattest possible frequency/amplitude response from the sound reproduction system, including the loudspeakers. Lip service was paid to signal phase and associated time domain effects, viz: do the right thing if you can, but not at the expense of other more subjectively apparent performance criteria.

Having in mind available signal sources up to that period, with strictly limited dynamics, treble, phase and transient response, the conservative view was understandable. But as better microphones, direct-cut discs and digital master recordings began to capture the true transients in percussive music, hifi enthusiasts began to listen for and expect equivalent 'attack' in reproduced sound.

Phase response

In a contemporary paper 'Loudspeaker phase measurements, transient response and audible quality' (AES 48th Convention, California, USA) author Henning Moller of Bruel & Kjaer voiced the emerging body of opinion:

> *A poor phase response has no influence on the reproduction of pure sine waves; nor on steady state music such as a sustained chord from an organ. But it shows up in transients, such as booms from kettledrums or bass drums, pizzicato from strings, short blasts from horns, attack on piano and guitar, and the clash of snare drums, cymbals and triangles.*
>
> *As an example of time-related phase distortion, consider the kettledrum with all its different frequencies. Correct reproduction of such a signal requires that all the spectral components are reproduced with their correct amplitude and time relationships.*
>
> *If the amplitude response curve of the loudspeaker is linear, the relationships between the low and high frequency amplitudes will be correct also. If the phase response curve is linear, then the low and high frequencies will reach the ear in the correct time order.*

Unfortunately, Moller added, loudspeakers normally introduce frequency dependent phase shifts:

Introduction to hifi

Frequency components with large negative phase shifts arrive at the listener's ear later than those with small phase shifts; the result is a signal distorted in the time domain. This is particularly critical when the original signal contains transients.

He points out that a transient can be expressed as a combination of a near-infinite number of sine waves. A square-wave signal – essentially a repetitive sequence of step function transients – can be shown to comprise an ostensibly infinite series of sinusoidal odd harmonics, in phase.

For the sake of clarity, Fig.3, reproduced from Moller's original paper, depicts a single segment of a square wave (A), along with the 'fundamental' or first component harmonic (B), the third harmonic (C) and the fifth harmonic (D), all in phase.

If recombined graphically (or electrically), the 'envelope' sum of B, C & D alone would have a discernably 'squarish' configuration (E), becoming progressively more rectangular with the addition of further higher-order odd harmonics.

Curves (F), (G) and (H) show the same three harmonics, but shifted in phase by 90°, and therefore staggered in time, as indicated. Although composed from signals of exactly the same frequency and amplitude as before, their sum (I) bears no obvious resemblance to (E) – an observation that applies, in principle, for any other arbitrary phase relationship between the component harmonics.

While such graphs (and CRO patterns) may be very convincing to the eye, some still question whether they are equally relevant to sound waves, as heard. By their very nature, they claim, ears respond primarily to individual component frequencies rather than to their instantaneous sum.

As a practical expression of this view, while many manufacturers place strong 00000 emphasis on phase response, other contemporary loudspeaker systems still show little evidence that it has received any more consideration than is technically or commercially convenient.

Frequency dividing networks, for example, are invariably tailored to ensure the flattest available frequency response and an acceptable overall impedance curve. Their phase characteristics may or may not receive comparable attention, depending on economic factors, marketing strategy and the convictions of the design team.

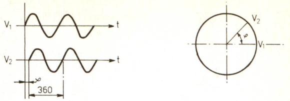


Fig.3(a): The relationship between time delay and phase shift.

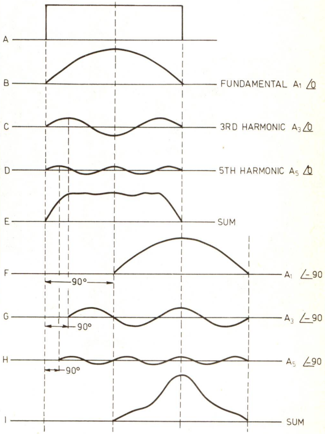


Fig.3(b): A square wave (A) can be expressed as, and/or reconstructed from odd harmonics (B,C,D & E). But if the same component harmonics are subject to relative phase shifts (F,G & H), the new sum resultant (I) takes on a quite different shape.

Unfortunately, as already indicated, the complexities of crossover networks do not lend themselves to a concise and easily readable analysis in an article of this nature. Most readers can do little, therefore, than accept the assurance of whoever sounds the most convincing!

Perhaps the most appropriate observation, here, is that a detailed performance specification covering phase response is indicative of a rigorous design approach, and a factor that should be considered when contemplating a new hifi loudspeaker system. At the same time, lack of such information does not conclusively brand a competitive system as inferior in terms of subjective sound.

Acoustic path length

An aspect of time domain distortion that is, fortunately, more readily comprehensible has to do with the axial alignment of multiple drivers, when mounted in an enclosure, relative to the listener.

To minimise diffraction effects from cabinet contours at high audio frequencies, it is normal practice to mount the tweeter on the front face of the baffle, such that its small cone is substantially flush with – and a continuation of – the outer surface. The high frequencies would obviously emanate from that plane.

By contrast, the woofer, with its large deep cone, is commonly mounted *behind* the baffle. The 'acoustic centre' of the woofer cone (Fig.4a) or the mean plane from which the sound radiates, depends on the frequency but is commonly well back towards the apex, and therefore several centimetres further away from the listener.

For a conventional cone type squawker, the acoustic centre would fall somewhere between the two extremes, as indicated.

With a square function transient fed simultaneously to each of the drivers, a listener, seated symmetrically in front of such a system, could be expected to hear component harmonics from the tweeter very slightly ahead of those from the squawker, and somewhat further ahead of those from the woofer.

Fairly obviously, the end result of the differential time delay – distortion in the time domain – would be comparable to the situation depicted in the lower section of Fig.3. As such, it would represent a potential liability in terms of transient response, and a reason to seek better time alignment of the acoustic centres.

The situation in Fig.4a could be partially corrected, for example, by substituting a dome type squawker, physically aligned with the tweeter, and fitting a shallower woofer, recessed into the face of the baffle.

Typical systems

Some manufacturers have, in fact, produced drivers with flat disc 'cones', which obviate any ambiguity in relation to the acoustic centre and allow it to be aligned with the face of the baffle, as depicted in Fig.4b.

For those with access to back issues, an article on the subject appeared in the July 1980 issue of this magazine. Up to that time, most such disc/cones had been moulded from specially selected foam plastic faced, as a rule, with aluminium foil. The July '80 article, however, introduced a new all-aluminium 'sandwich' technique, developed by Technics, using a light but rigid inner 'honeycomb', faced on both sides with foil (see accompanying illustration).

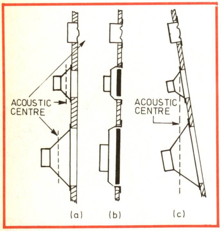


***Fig.4:** If the acoustic centres of multiple drivers are not in line (a), the frequency components of transients reach the listener at different times. Typical corrective measures are shown at (b) and (c).*

As a matter of further interest, internal vibration modes were minimised by the use of a relatively large diameter voice coil coinciding with the principal vibration node.

Drivers involved in the original Technics 'honeycomb disc' range included three disc woofers, a disc squawker, and a matching disc tweeter. Also included was a so-called 'leaf' tweeter, using an ultra-light honeycomb strip flexibly suspended in what was otherwise a ribbon tweeter configuration. Claimed response was to 125kHz, for program levels peaking up to around 100W.

The honeycomb-disc technology appears to have been very successful, figuring large in the Technics high-performance loudspeaker range ever since.

Another approach, which avoids the need for special drivers, has been to tilt the baffle backwards, as in Fig.4c, to vertically align the acoustic centres.

A variation of this method is to step the baffle so that the section carrying the dome tweeter(s) and squawker(s) is set back slightly from that carrying the woofer. By way of example, refer to the 'time aligned' Scanspeak 300 system, described on page 84 of the April 1986 issue of this magazine.

While inclined and stepped baffles present their own problems in terms of enclosure construction and aesthetics, they do allow the designer freedom to use drivers which may be preferred for other reasons – technical and/or commercial.

As with frequency dividing networks, time aligned or 'linear phase' configurations are worthy of serious consideration by prospective purchasers, although not necessarily to the exclusion of other systems, some enthusiastically promoted in the marketplace by the very same manufacturers!

Indeed, some deliberately unconventional systems using up-, down-, side- or rear-facing drivers, and surround-sound music systems generally, would appear to play down a rigorous approach to phase, in favour of other sonic effects considered to be more entertaining than crackling transients!

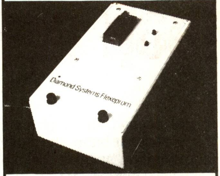
If nothing else, the above observation emphasises the subjective nature of reproduced sound.

Indeed, having ploughed through the theory, and heard all the arguments, the most appropriate loudspeaker system for a household is probably the one that best presents the music they like, to the ears they have, at a price they can afford!

(To be continued)

Flexeprom

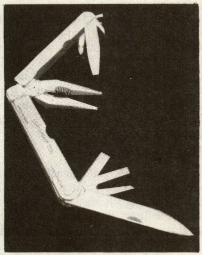
Programming versatility at a competitive price.



◆ Able to program just about any CMOS/NMOS EPROM, EEPROM, MPUS and TTL PROMS.
◆ Powerful easy to use host software provided – includes screen based editor.
◆ Intelligent and normal programming.
ALL AUSTRALIAN
◆ Designed and manufactured by

Diamond Systems

P.O. Box 105 Hurstbridge 3099
(03) 714 8269. FAX: (03) 714-8554



ORIGINAL U.S. MODEL

LEATHERMAN® TOOL

- Needlenose Pliers
- Wire Cutters
- Ruler
- 3 Screwdriver Sizes
- Metal/wood File/saw
- Regular Pliers
- Knife Blade
- Can/Bottle Opener
- Phillips Screwdriver
- Awl/Punch
- Belt Sheath Included

$68.00 p.p. VISA

Available from: **THE KNIFE SHOP**
25 LONSDALE ST
BRADDON, A.C.T. 2601

Broadcast band loop antennas - 2

In this second article of his short series on loop antennas for the broadcast band, the author gives his design for a passive loop antenna suitable for use with a wideband AM tuner. It is especially suitable for country listeners.

by NOEL S. ERBS

Following on from the work described in Part 1, experience with a passive loop antenna was gained by building one about two years ago to suit the Wideband AM Tuner described in the issues of *Electronics Australia* between December 1982 and March 1983.

As a result of trials which confirmed the low signal output of passive loops, a large size was adopted. The final design was a 3.7m x 2.5m rectangular single turn loop of 24/0.20 wire, mounted above the carport roof on a DSE 50kg rotator as shown in Fig.1.

The location was determined by the need for as short a lead-in as possible, and the overall dimensions were limited by available space and aesthetics. The original balanced lead-in to the receiver was 300 ohm TV ribbon. It was subsequently replaced by 6m of twisted pair 32/0.20 wires, but no change in signal level was noticeable.

Receiver changes

To obtain adequate signal during the day from distant stations, even using this large loop, it was necessary to rewind the tuner's antenna input toroid, originally 130T (CT) to 65T, trifilar wound. The new windings are 58T (CT) to 138T (46T trifilar), dictated by wire sizes used and available space for single layer windings, secondary over primary.

The wide range of signal levels, headed by 2WG, ruled out using a preset antenna attenuator potentiometer as specified in the original tuner design. Instead, it was re-located and geared to a knob concentric with the tuning control. It must be adjusted well back for 2WG and back a little for 2RG and 2CO, but signals from other stations need no attenuation during the day.

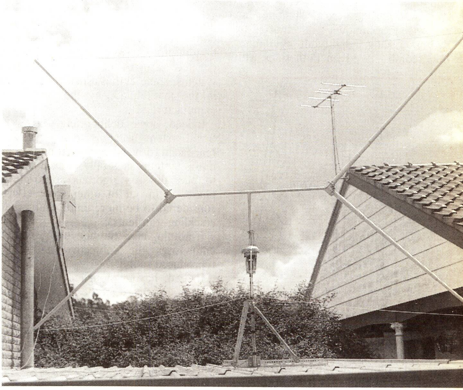
This antenna and receiver combination exhibits a low level of background noise, easily demonstrated in a subjective two receiver side-by-side listening test using a Sony ICF2001 fed from a 20m elevated wire antenna.

As a further indication of low noise, if one of the lead-in wires is disconnected at the receiver (the loop becomes an elevated wire feeding half the input winding to ground) there is an objectionable increase in background noise.

Loop orientation

Orientation of the loop for peak signal is best achieved by rotating it to its sharp, deep null, then noting the angle and resetting the controller by 90°.

However, because of the relatively broad response angle of the loop, most of the time it is left aligned roughly SW-NE. This is a good compromise at my location for 2WG, 2CO, 2RG, 2CY, 2CA, 3WV and 2CR – especially at



The author's passive loop antenna, mounted on a rotator so that it can be orientated to optimise reception for each station. It's not small, but long-distance reception is significantly improved.

night, when the directional properties of the loop are diminished.

It is worth noting that the rotator used boasts a simple 3-wire interconnection and does not rely on position feedback. After many angle changes back and forth, the antenna position can get out of alignment with the control knob. The instruction sheet advises a periodic full rotation CW and then CCW to reset registration, and this procedure works.

Construction

A welded steel pipe centre frame in the shape of a 'T' is carried by the antenna rotator. The four PVC pipe arms are glued into stock 90° PVC elbows which are secured, using exhaust pipe clamps, to formed angle iron end brackets welded to each end of the horizontal pipe.

Note that the three glued step joints in each PVC arm required use of a lathe. The wire loop is not firmly bonded at the four support points, yet no drooping of the cantilevered arms from plastic 'creep' is evident after 2 years.

A vertical aluminium bar bolted to the top section of the rotator provides an anchor point for two egg insulators. To delay embrittlement of the PVC by direct sunlight, it was painted grey. This antenna is not particularly rigid but has survived several violent wind storms undamaged.

Conclusion

Clearly, capital city residents would not need such a large antenna, but the experiences outlined may well be of interest to other country listeners.

The antenna described has proved quite satisfactory in Wagga Wagga for daylight reception of distant stations. Overall sensitivity of the combination is not as high as the Sony ICF2001 and 20m wire antenna, but Sydney station 2KY can usually be copied during the afternoon.

A passive loop has been retained for this receiver rather than install a tuned loop, for two reasons. Firstly, to keep it 'user friendly' – family members are reluctant to adjust the antenna rotator, let alone tune an antenna to a peak too. Secondly, a high Q tuned loop could adversely affect the wideband tuning of the particular receiver being used.

In the final part of this series, I will look at the performance of tuned loops.

Reference

Clarke: A Wideband AM Tuner, in *Electronics Australia* December 1982-March 1983.

ELECTRONICS
EXCITING JOBS WITH A FUTURE

GET YOUR TRAINING NOW
AND BE PREPARED FOR THE FUTURE

If you're interested in electronics, a Stott's Home Study Course can make it even more interesting. It could lead to an exciting career in the fast-growing field of electronics.

Stott's electronics courses offer plenty of practical work and 'hands on' experience through custom-designed kits. You'll be skilfully guided by experienced, professional instructors, with individual attention and advice. You study at home, at your own pace.

Choose from Stott's range of electronics courses:
Introduction to Electronics, Radio and Television Servicing, Radio Receivers, Colour Television, Introduction to Micro Computers, Digital Electronics for Technicians & Servicemen or Industrial Electronics.

MAKE YOUR MOVE TOWARDS A BRIGHTER FUTURE. SEND THE COUPON TODAY.

Stotts
CORRESPONDENCE COLLEGE
Proudly providing Australian training for Australian jobs
a tradition that's 80 years strong

AN AUSTRALIAN TRADITION

PLEASE SEND ME FREE, AND WITHOUT OBLIGATION,
FULL DETAILS OF THE FOLLOWING COURSE:

________________________________ (PLEASE PRINT)

MR. MRS. MISS. ________________________ AGE ________

ADDRESS ________________________________

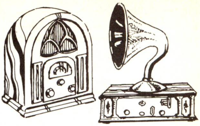
________________________ POSTCODE ________

Stott's undertake that no sales counsellor will visit you.
Melbourne, 140 Flinders Street. 3000. Tel: 654 6211
Sydney, 383 George Street. 2000. Tel: 29 2445
Brisbane, 65 Mary Street. 4000. Tel: 221 3972
Adelaide, 226 Pulteney Street, 5000. Tel: 223 3700
West Perth, 25 Richardson Street, 6005. Tel: 322 5481
Hobart, 2 Davey Street. 7000. Tel: 34 2399
New Zealand, Box No. 30-990. Lower Hutt. Tel: 676 592

ALA/ST6820/EA289

Vintage Radio

by PETER LANKSHEAR



The Atwater Kent 20C

The Atwater Kent brandname was very widely known in the 1920's, not only in the company's home country (the USA) but here in Australasia as well. And one of the classic A-K radio receivers was the model 20C, released in 1925.

One of the most respected names in early American radio manufacturing is that of Arthur Atwater Kent. At the beginning of the century, he had become a very successful maker of automobile electrical components, featuring high quality metal pressings and Bakelite mouldings. In 1907, he invented the single spark, automatic advance ignition system, still in use today.

When radio 'took off' in the early 1920's, his specialist market in automotive components was falling off, but he was in a good position to make finely finished superior radio components including variometers and transformers.

Radios without cabinets

Atwater Kent's Bakelite mouldings were beautifully finished and their rich brown colour became, together with polished metal work, almost a trade mark. By 1923 he was assembling his products into built-up radios.

These early receivers were not given cabinets, but the components were mounted on polished mahogany bases. Known as 'Breadboards', they are today highly sought-after by collectors, and to see one is to understand why. Apart from the novel construction, the combination of lacquered mahogany with finely finished Bakelite and metal, makes a very attractive combination. Few, if any, were sold in this part of the world.

The most successful Breadboard was the Model 10, comprising two R.F stages, a grid leak detector and two audio stages. Mr Kent refused to pay royalties to the Hazeltine Corporation for rights to Neutrodyne patents, so his receivers used simple grid resistor stabilisation. His factory, located in Philadelphia, did make some receivers using only two tuning controls, but the standard at this time was the classic three tuning control receiver, produced by literally hundreds of manufacturers.

By the end of 1924, the public were ready for less technical looking radios, so Atwater Kent took the model 10 and put it into a simple mahogany cabinet, naming it the model 20, which sold well.

Most manufacturers used engraved Bakelite or Formica front panels, giving their radios the appearance of laboratory instruments. These panels were expensive and created production bottlenecks. With his usual flair for creating attractive equipment efficiently, Mr Kent produced instead, a metal panel sprayed in a fine wrinkle grey/brown paint, which nicely complimented the mahogany cabinet.

Enter the 20C

His good marketing instincts told him that a compact radio would appeal to lady customers, so he compressed the cabinet of the model 20 down to 50cm long by 15cm depth and height. Only half the height of the model 20, it was, at the time, probably the smallest 5-valve radio on the market. Called the Model 20 Compact (20C) part no. 7570, it was an immediate success and by the end of 1925 some 163,000 had been made.

At this stage, RCA introduced a far-reaching change in valve manufacture, and consequently, US radio receivers for 1926 had to be modified.

At its introduction in 1923, the standard American triode had a bayonet base with four stubby pins. The change for the 1926 season was to substitute the more familiar long-pin base, with filament pins of greater diameter that those for grid and anode. Sockets for these new UX201A valves could be cheaper and have greater pin contact area than the previous UV style.

This change is a very good indicator of the age of early battery receivers. If the valve sockets are of the long pin

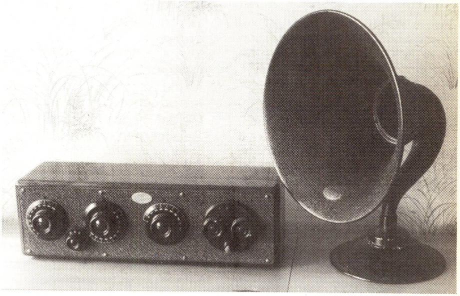
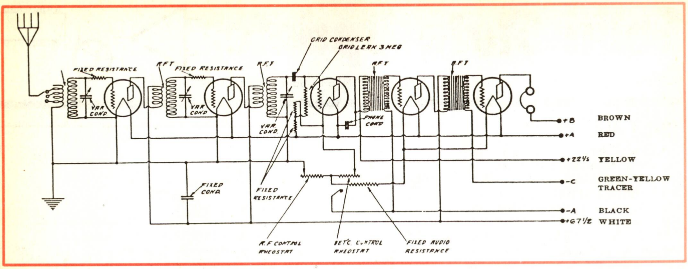


Fig.1: The Atwater Kent 20C was an attractive, well-proportioned and beautifully finished receiver.



The circuit for the Atwater Kent model 20C MkII, part number 7960.

pattern with larger diameter filament pins, the radio is post 1925. There is no mistaking UV sockets. They have a skirt that surrounds the valve base, with a slot or channel for the bayonet pin and the contacts are visible from the top. The post-1925 or UX style of 201A will fit either socket, but of course, the much rarer UV based valves are not interchangeable.

Changes for 1926

Naturally, A-K soon made the socket changes, the new 1926 20C having the catalogue number 7960. This is the version most likely to be found in Australasia. When production ceased in 1927, by which time single knob tuning had become general, 63,000 had been sold.

Other modifications were included in the 7960 pattern. The filament circuits were altered so that the audio valves were not controlled by a rheostat, but ran at the full 5.0 volts. The biasing was also rearranged so that higher HT voltage could be applied to the output stage.

Another change was in the first audio transformer. Originally, the two transformers were of the same pattern, in narrow cylindrical cans. Their construction was of a type that disappeared during the mid 1920's. Called descriptively 'hedgehogs', they were a development of the traditional induction coil and an obvious construction method for an erstwhile automotive electrical manufacturer.

The core was a bundle of soft iron wires centred in a bobbin containing the two windings, and the ends of the iron wires were fanned out and brought round over the outside of the bobbin to close the magnetic circuit. Again using automotive practice, the assembly was sealed in pitch.

In the 7960 model, the transformer connecting the detector to the first audio stage was changed to the more familiar pattern using silicon steel laminations, and requiring a larger diameter can.

The reason for this change was probably that the iron wire core produced insufficient inductance for an adequate bass response when fed from a grid leak detector. As the following second audio stage would have been less demanding, the iron wire core would have been adequate. This retention of earlier components is a characteristics of A-K receivers. In every model can be found earlier style components. New design in Mr Kent's receivers was a steady evolution, more so than with most manufacturers.

Unshielded RF coils

There were no shields around the RF coils. Instead, they were mounted at the rear of their associated tuning capacitors and to minimise coupling, were orientated so that they were mutually at right angels.

Neutrodyne royalties increased the price of a neutralised receiver by as much as 25%. Always an astute businessman, Atwater Kent continued using the cheaper grid resistor stabilisation of his receivers. The 800 ohm resistors were inductively wound, with resistance wire on small pieces of fibre mounted on the rear of the tuning capacitors. It is likely that careful positioning of the coils and the inductive nature of the resistors contributed largely to stabilisation.

To cater for varying aerials, the primary winding of the antenna coil was tapped and connected to a neat little three-position rotary switch. The three tuning knobs were engraved 0-100 and

Continued on page 144

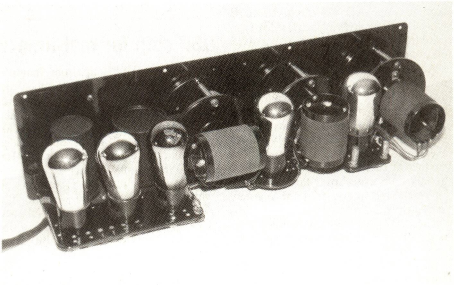


Fig.2: There wasn't much wasted room inside – a very early example of steel chassis construction.

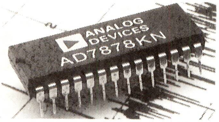
Solid State Update

KEEPING YOU INFORMED ON THE LATEST DEVELOPMENTS IN SEMICONDUCTOR TECHNOLOGY

12-bit ADC for DSP

A new 12-bit analog-to-digital converter chip from Analog Devices combines track-and-hold amplifer (T/H), first-in first-out (FIFO) memory, and reference all on a single CMOS integrated circuit.

The AD7878's 100kHz sampling rate – including the acquisition time of the T/H – makes the ADC well-suited for audio-bandwidth applications. The 41ns bus access time – the fastest in the industry – means that the ADC can connect directly to most high-speed signal processors, eliminating the need for external wait-state logic. An on-chip FIFO can store the results of eight consecutive conversions before a processor must interrupt its execution to read data. This last feature dramatically reduces software overhead in signal-processing systems.

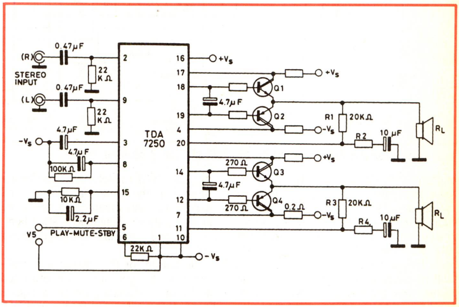


The AD7878 is manufactured in an advanced BiCMOS process. In addition to low CMOS power consumption (60mW typical) the process offers high accuracy. The AD7878 offers ±1/4LSB typical relative accuracy, ±1/2LSB typical differential nonlinearity, and ±6LSB maximum full-scale error.

An on-chip Status/Control Register monitors the condition of the 13-bit, 8-word FIFO; 12 bits are for data and 1 bit indicates if the sample is overrange. This register can flag conditions such as FIFO almost full, FIFO empty, FIFO overrun, out-of-range data, and the number of samples stored in the FIFO. 'Reads' and 'writes' over the ADC's 12-bit resets and interrogates the register, respectively.

The AD7878 accepts a bipolar input range of ±3V at maximum frequencies up to 50kHz.

For further inforamtion contact Parameters, 25-27 Paul Street North, North Ryde 2113 or phone (02) 888 8777.



High voltage stereo driver

A high voltage bipolar IC, the SGS-Thomson TDA7250 drives two discrete transistor output stages in hi-fi stereo amplifiers delivering 2 x 15W to 2 x 100W.

Because it can operate on supplies up to 90V the TDA7250 reduces the size and cost of the mains transformer, replacing the cumbersome discrete circuits used previously for high voltage drivers.

The TDA7250 has other benefits, too. It includes an automatic control circuit for the output stage quiescent current, so no trimming is needed in production and thermal stability is guaranteed without temperature sense elements.

Moreover it protects the output transistors against current overload and it includes input bias control circuitry to eliminate spurious noises when the audio is muted.

For further information contact Promark Electronics, 104 Reserve Road, Artarmon 2064 or phone (02) 439 6477.

DSP chip for real-time video processing

The latest DSP chip from Inmos is the IMS A110, claimed to open the door to a host of applications wherever video signals are processed in real time.

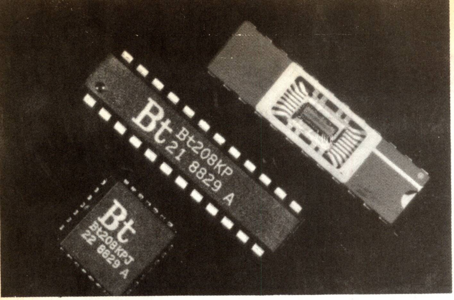
The IMS A110 can execute over 400 million operations per second, on video data clocked at speeds up to 20MHz. The DSP's number-crunching power is derived from parallel processing, in which digitised data flows through a pipeline of 21 multiplier accumulators. The pipeline can be configured as a single linear array or as a three by seven, two-dimensional window.

Any number of A110's can be cascaded in an extended pipeline, to attain even greater performance.

Packaging is in a 100pin ceramic PGA and the device consumes less than 2W. It packs over 400,000 transistors on a single CMOS chip, measuring 8 x 10mm.

Envisaged applications include, robot vision systems, medical imaging, high-definition and low bandwidth television, night vision systems, document scanners and processing satellite pictures. All of these systems call for significant number crunching to convert poor quality images into enhanced or data reduced formats that can be manipulated by conventional microprocessors.

For further information contact Hawk Electronics, 203 New South Head Road, Edgecliff 2027 or phone (02) 32 5095.



8-bit ADC for image acquisition

Brooktree Corporation has introduced the Bt208, an 8-bit flash, video analog-to-digital converter. Brooktrees's first A/D Converter, the Bt208 is designed specifically for image capture equipment such as picture transmission systems, broadcast video, scanners, capture boards and medical imaging devices. To meet the needs of this equipment, the Bt208 integrates many special imaging features, substantially reducing the number of external components and PC board area required to implement image digitisation circuitry.

The Bt208 utilises flash converter topology to achieve 20 million sample per second (MSPS) speeds. This high sampling rate allows up to four times oversampling of NTSC, PAL and SECAM video signals, giving the engineer flexibility and a margin for worst case situations.

Designed specifically to fit the specifications of image capture applications, the Bt208 requires no additional video amplifier to meet input level requirements. It features an analog input range of 0.714V to 1.2V, which covers the NTSC, PAL, SECAM and RS-343A video standards. Many other A/D converters available today require 2V input signals, making it necessary to use an additional high speed amplifier.

External zero and clamp control allows AC coupled video signals to be DC restored during each horizontal blanking interval. This eliminates the need for additional circuitry to perform DC restoration. An output enable control allows the data outputs to be three-stated asynchronously to the clock, eliminating the need for a TTL three-state buffer in most applications. In addition, the Bt208's on-chip reference eliminates the need for an external voltage reference and op-amp.

For further information contact Energy Control International, 26 Boron Street, Sumner Park 4074 or phone (07) 376 2955.

18-bit ADC for wide dynamic range audio

The OEM products division of dbx has come up with a new development that should be of particular interest to audio DSP makers worldwide.

The product is an 18-bit analog-to-digital converter chip set, reputedly one of the first of its kind in the world. The chip set is aimed at OEMs seeking to achieve a wider dynamic range, that is, a lower noise level in the conversion process for analog to digital.

As local distributor Amber Technology's David Hudson explains, "The more bits used in the conversion process, the wider the dynamic range. At present the industry mainly uses 16-bit converters. These theoretically produce a dynamic range of 96dB, but the key word here is 'theoretically'; in practice, the range is closer to 90-92dB."

"The 18-bit converter can provide a dynamic range of up to 104.5dB – quite a dramatic improvemnt, as you can see."

dbx, through its distributors worldwide, will be marketing the 18-bit converter chip set to OEMs and others requiring high quality analog-to-digital converters in the front end of their systems.

For further information contact Amber Technology, PO Box 942, Brookvale 2100 or phone (02)

New high-speed CMOS logic

Toshiba Corporation has started the mass-production and marketing of a new series of Advanced CMOS Logic. The TC74AC series with a typical propagation delay time of 3.5ns, which is equivalent to that of the fastest bipolar logic ICs such as FAST, realises the low power consumption characteristic of CMOS devices, as well as low switching noise.

As the first line up for the new series, Toshiba has introduced 40 devices available in both DIP and SOP packages, and plans to increase the number of models to 100 by the end of 1989. The new devices are expected to be used in such equipment as workstations, laser beam printers, personal computers and PBXs (private bench exchanges), which require high speed and low power consumption.

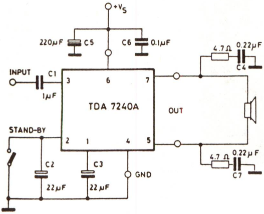
Since 1987, several companies worldwide have been shipping high-speed CMOS logic ICs in small volumes, but these devices have a major drawback in that various noises including switching noise, which occur during fast switching of transistors, cause errors of output information. Some companies have tried to solve this problem by changing the pin allocation (center pin layout), but this creates additional work for users who must re-design their circuit boards, CAD software, etc.

Toshiba's researchers succeeded in eliminating errors of output information by reducing the switching noise to nearly half the voltage (1.2 to 1.3V) of recently available ACLs with corner pin layout. Moreover, by improving the output circuit, the researchers achieved this low noise level without changing traditional pin allocation (corner pin layout), so that users are freed from the necessity of changing their circuit design.

In addition, the new devices in SOP packages for surface mounting, feature noise level 30% lower than that of devices in DIP packages (0.8V). This means SOP-packaged devices are more suitable for connection to TTL (transistor-transistor-logic) devices, which are more sensitive to switching noise than CMOS logic ICs.

Maximum clock frequency of the new family is 150MHz while power consumption (standby) is 0.01uW. Output current (high/low) is -24mA/24mA.

Solid State Update



20W bridge amplifier

A 20W amplifier designed for car radio applications, the SGS-Thomson TDA7240AA can drive a single loudspeaker in a bridge configuration, delivering up to 4A output current.

Assembled in the compact Heptawatt 7-lead plastic power package, this device needs few external components and occupies very little board space, making it particularly suitable for high power four-speaker car stereos.

Internal circuitry protects the device against short circuits, making it virtually indestructible. In addition it incorporates a standby function.

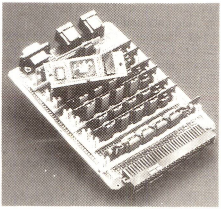
For further information contact Promark Electronics, 104 Reserve Road, Artarmon 2064 or phone (02) 439 6477.

Silicon-intensive, 3-D packaging

Electronic systems snap together with pretested subassemblies called 'SipStiks', claimed by maker Dallas Semiconductor to yield densities five times greater than those available with single-sided surface-mount construction.

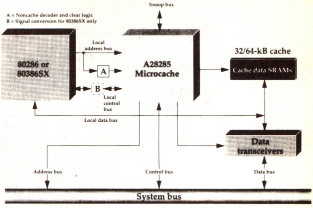
SipStiks are chip-laden, leadless substrates conforming to the JEDEC standards first made popular by single in-line memory modules, sometimes referred to as DRAM SIMMs. The prefabricated SipStiks are the size of a stick of gum, yet are complete subsystems. Initially, five SipStiks are available, with a total of 20 to be offered by the company over the next year.

The SipStiks arrange components more densely than traditional surface mount packing schemes by taking advantage of three rather than two dimensions. More specifically, SipStiks stack perpendicularly to the mother board plant, mounting by way of a recent advancement from PMP Inc. called MICRO-EDGE connector. The SipStik can be attached to the motherboard at an incline of height reduction.



Now available are the DS2217 One Million Bit Nonvolatile Static RAM SipStik; the DS2212 16K x 9 FIFO SipStik; the DS2250-8 Soft Microcontroller SipStik with 8K bytes; the DS2250T-32 Time Microcontroller with 32K bytes; and the DS2267 ADPCM Speech Compression SipStik with four or eight channels.

For further information contact Alfatron, 5/14 Jersey Road, Bayswater 3153 or phone (03) 720 5411.



System block diagram

Fast cache controller for 80286/80386 systems

Austek Microsystems has announced the industry's first integrated cache controller for 20MHz and 25MHz 80286 and 80386SX-based systems. The A28285 maximises the throughput of these microprocessors enabling personal computers to reach new, high levels of performance.

Austek was the first to introduce an 80386 cache controller in 1987, which was very well received by system designers and has enjoyed great success in the market.

Memory in personal computers using the A28285 is more efficiently utilised, because of the small cache of fast memory which stores the most frequently used information. This allows the system to operate with slower, less-expensive DRAMs but with speeds equal to the faster and more costly SRAMS.

Efficiency of a cache memory is measured by the 'hit' rate – that is the success in predicting what information will be needed by the processor. With its four-way, set-associative architecture, the A28285 achieves a 40% higher hit rate over the commonly used direct-mapped cache architecture.

Another advantage of the A28285 is its availability at speeds of either 20MHz or 25MHz. With this feature, no main memory redesign is required when shifting from a 20MHz to a 25MHz system board design.

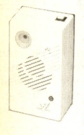
For further information contact Austek Microsystems, Technology Park , South Australia 5095 or phone (08) 260 0155.

EA MINI ADS

Rates: One insertion $195. Six insertions $180 each. Twelve insertions $170 each. Send order with remittance to THE ADVERTISING MANAGER, ELECTRONICS AUSTRALIA, P.O. BOX 227, WATERLOO, NSW 2017 by 15th of the month two months prior to issue date.

SOLID STATE MESSAGE RECORDER

As seen on 'Beyond 2000'



A device which records messages on a Memory Chip. It can be replayed many times by moving past the sensor, it can also be interfaced to existing circuitry and triggered by any desired function, it will instantaneously return to the start once replayed. It records messages up to 16 sec, operates from a 9V battery or any appropriate DC Plugpack. Ideal for the Alarm industry, Museum Etc.

Retail Price $50.00

from ARTHRITE AUSTRALIA,
16 Stortford Ave, Ivanhoe West, Vic.
Tel. (03) 499 6606, Fax (03) 497 1336.
Wholesalers/Manufacturer enquiries are welcome.

HARDWARE AT DISCOUNT PRICES

MINISCRIBE HARD DISKS	
20 MB WITH CONTROLLER	$455
30 MB WITH CONTROLLER	$510
40 MB WITH CONTROLLER	$590
80 MB VOICE CELL	$1050
EGA CARD	$250
VGA CARD	$360
FAX CARD	$795
386 MOTHERBOARD (20 MHZ)	$1995
AT MOTHERBOARD (12 MHZ)	$500
XT MOTHERBOARD (10 MHZ)	$140
AT 2 SERIAL PRINTER	$85
EGA MONITOR	$610
MULTISYNC MONITOR	$840
CGA MONITOR	$450
ETHERNET CARD	$380

FREE CATALOGUE

COMPANION COMPUTERS
Factory 3/12 Florence St, Burwood, 3125.
Ph: (03) 288 3835. Fax: (03) 288 8116

KITS THAT WORK!!
(If properly assembled)

★ **EVERPOPULAR — UHF REMOTE CONTROL KEY (Inexpensive)**

All transmitter kits with case (EA Jan '87)	**$14.50**
New transmitter kit with case (EA Jan '89)	**$19.99**
Receiver PCB components kit (EA Jan '87)	**$34.90**
12V lighter battery for transmitter (extra)	**$ 2.00**

* **ULTRASONIC BURGLAR ALARM (SC May 88)**
Bonnet, boot, ultrasonics, back-up battery, flashing light, Xtal controlled.................................. **ONLY $39.90**
40 Khz tandsucers $14.50 pr extra

* **EVER POPULAR MINI PIEZO SCREAMER AT THE BEST PRICE: $16.50**

★ **FUEL CUT OUT SOLENOID**.................... **Complete Kit**
See review in New Products EA Dec '88. A bargain at only **$57.90**

***FOR A REAL BARGAIN! QUALITY EX-TELECOM POWER SUPPLIES:**
See review in Oct 88 SC.. CLEARANCE AT ONLY $20.00 ea
P+P $3 – POWER SUPPLIES P + RAIL FREIGHT APPROX $6

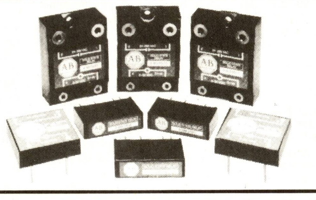
OATLEY ELECTRONICS
MAIL: P.O. Box 89, Oatley, NSW 2223
SHOP: 5 Lansdowne Parade, OATLEY WEST
PHONE: (02) 579-4985
Bankcard, Mastercard and Visa Card Accepted With Phone Orders.

AB QUALITY

SOLID STATE RELAYS

NOW EVEN BETTER!

RELAY FEATURES:
- High surge current capabilities.
- Zero voltage switching for low RFI.
- Opto isolated input/Output terminals increased to 4KV rms.
- Inbuilt snubber.
- Industry standard packaged format.
- Logic level control signals.
- Type A-B BASEEFA approved for hazardous applications.
- Meet UL flammability standards.
- Chassis mount and PCB mount.
- Phase control option.



LOAD CURRENT:
Type A-BM: 3-4 amps (Irms). Vertical mount.
Type A-BP: 3-4 amps (Irms). Horizontal mount.
Type A-B: 10-45 amps (Irms). Vertical mount.

INPUT VOLTAGES:
Types A-BM, A-BP, A-B(D): 3-32V DC.
Type A-B(A): 90-280V AC.

LOAD VOLTAGES:
New high voltages 24-480 (Vrms).

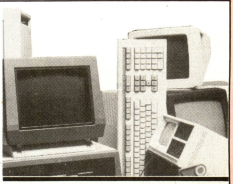
ALLEN-BRADLEY, WORLD KNOWN FOR CONSISTENT QUALITY.

ALLEN-BRADLEY
A ROCKWELL INTERNATIONAL COMPANY

VIC: 37 Chapman Street, Blackburn 3130 Ph: (03) 899 0335
NSW: 56 Parramatta Road, Lidcombe 2141 Ph: (02) 648 2652
ACT: P.O. Box 534, Fyshwyck 2609 Ph: (062) 80 4554
QLD: Unit 4 Dennis Court, Springwood 4127 Ph: (07) 208 1044
SA: 30-40 Hurtle Square, Adelaide 5000 Ph: (08) 232 0001
WA: 31 Kensington St, East Perth 6000 Ph: (09) 221 2121

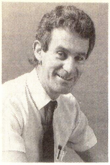
your computer

NEWS
REVIEWS
PROGRAMS
TUTORIALS

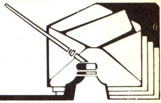


A magazine for all computer users and enthusiasts, Your Computer has something for everyone — topical features on all aspects of the computing world, expert reviews of the latest software and hardware, up-to-the-minute information for business people and even games and advice for hobbyists.

Available monthly at your newsagent or subscribe now by phoning (02) 693-9517 or 693-9515.



Information centre



Conducted by Peter Phillips

A mixed bag

Last month we introduced a few changes to Information Centre by adding more variety. So in line with the revised format, we offer this month's range of questions, answers and miscellany, mostly supplied by readers.

In case some of you are not aware of the function these pages are now performing, here's a brief recap. I invite readers to send letters that not only seek information about problem projects, but about technical matters in general. You may have a general question; or perhaps an answer to a question. Maybe you can pose a stinker of a problem that will have readers (and ourselves) scratching around for an answer. Or how about some examples of technical stupidity – we all enjoy a bit of a laugh now and again.

And the more letters we receive, the better – it will give variety that other readers will enjoy.

OK, having recapped, let's see what's offering from the mailbag this month. It seems the Guide to Education article I wrote (Nov) is still drawing some commentary. We also have some mail on the Multi-mode video card presented in June 88 – quite a bit in fact. There is also a suggestion for a project and some letters seeking information. So, as ever, a mixed bag. Here goes...

Calling Tim Gregory

We like to pay our contributors, but we need to know the address for the cheque. If Tim Gregory, a contributor to December's** Circuit and Design Ideas **would like to contact us and give us his full address, we would like to send him some money.

What's an engineer?

It seems there is some confusion concerning qualifications in electronics, (ref Education article Nov 88). I ask what is an 'engineer' anyway?

In fact, what does a diploma-certificate-degree-associate diploma etc., mean? If one gains any of these qualifications in Australia, then surely it is a deplorable state of affairs that all states do not equally recognise them. And why should someone who has gained his training in the armed forces not get equal recognition outside?

However, my main question concerns someone, say a bricklayer, who undertakes a correspondence course in electronics. Perhaps this person wants to learn about TV repair, computers, or servicing in general. Will his qualification be recognised?

EA advertises several private learning institutions that offer a correspondence course in electronics which would permit a person to study while holding a full time job in an unrelated area. What's the use if the qualification gained is not accepted?

Also, where does membership of TETIA stand as a means of having more recognition? (P.B., Glenorchy, Tasmania)

- Recognition of a qualification is a rather murky area. For example, an electrician can only undertake house wiring if he has passed a licensing exam conducted by the relevant state electricity supply authority. Here the qualification is recognised, or rather, is demanded, by the area inspector if the job is to be approved. A clear cut qualification requirement.

The natural belief, though, is that the applicant for the licence needs to be an electrician in the first place. In fact, anyone can sit for the exam, providing he/she can produce documentary evidence of having spent 12 months with an electrical contractor. The evidence must include a list of the jobs undertaken and proof that the applicant has been exposed to the practical aspects of electrical wiring. Because the exam assumes electrical knowledge, those with no theoretical background would not be able to pass, so some prior formal training is essential. But it need not be as an electrician. Interesting eh!

The electronics field is a rather unusual one, due mainly to the lack of unions to represent those in the field. Unlike most trade areas, anyone can undertake an electronics course, not just those employed in the field. This is how brickies can become TV technicians – and often very good ones.

To try and answer the main question posed by P.B., we need to examine the question – who requires the job applicant to have a specific qualification in the first place? Is it the government, employers, licensing authorities, unions?

It seems that employers all have their own criteria when employing someone in the electronics field. Some employers are only interested in the ability of the applicant, and will pose their own entry tests. Culling of the applicants may be done on qualifications, but if someone can perform the required task, then his qualifications, or lack of them, may not even matter.

However, in a competitive world, most employers will specify a particular qualification. For example, an engineer is often described as a person who, without further study, is eligible for membership to a particular professional organisation. Nothing to do with learning institutions, governments or even unions. It is very convenient for employers to then use the same criteria. In the repair industry, large industries will nearly always ask for a specific qualification. If the employer is in Victoria, he will ask for a Victorian qualification, not because it's better, but because it's Victorian. If an interstate person applies, he won't have that qualification. Maybe he can show the equivalence, but it's up to the employer to decide.

So, P.B., governments and learning institutions are really not to blame if company XYZ refuses employment to a person possessing a qualification other than that specified in the job advertisement. There are no bureaucrats moving the goal posts - its just the marketplace working in its usual mode.

The question of qualifications from a private institution is always a bit contentious. The fact is, if the employer only seeks demonstrable skills, then how you obtained them is irrelevant. If you want to work for yourself, then who cares about the source of the qualifications anyway, providing you can make a living.

Private colleges can get you into the electronics field, no doubt about it. But, a certificate from, say a TAFE college is more generally recognised – something the industry itself has decided. This doesn't necessarily mean TAFE is a better trainer, rather it means that more employers accept the training as being appropriate.

However, the private colleges can provide correspondence courses in a time frame to suit the individual. They fulfill a valuable role, and many have been around for years, proving that they must do something right.

TETIA is an organisation that provides technical support for its members, and requires 'appropriate' qualifications plus five years field experience plus a nomination from an existing member to join. The qualifications that are acceptable to TETIA include any radio/TV based trade course (any TAFE). Some of the larger private college correspondence courses are acceptable as well.

Being a member of TETIA certainly enhances a serviceman's status, at least as far as a cautious public is concerned. More information on TETIA (and TESA) can be found in *EA* for June 1987, on page 36.

So, the question of qualifications in electronics is somewhat open. Success is possible without any – providing you have the actual skills. But it is more likely if you have a generally recognised qualification. No single group can be held to blame if different employers demand specific qualifications – the employer pays the wage, and is therefore entitled to set his own qualification levels.

Certainly it is unfair if a job application is refused because the employer won't accept interstate qualifications due to his misconceptions about their equality. TAFE is trying to iron out these very problems, and many universities are moving in this direction as well.

There is no simple answer, unfortunately.

The next batch of letters concern the Multimode Video Card (June 88) from Energy Control International. This project was written up by EA, based on material supplied by ECI. It seems there are a few hassles, and I have lumped everything together in the form of a bulk answer. The first letter certainly raises a few points...

Multimode video card

I recently purchased a kit for the Multimode Video Card (EA June 88) from Energy Control International (ECI). However I would like some clarification concerning conflicting information presented in the article and the overlay for the PCB I received from ECI.

The parts list (p93) lists capacitors C1-C19 as 10nF mono, and C20-21 as 10nF, 16VW. The circuit diagram (p90) has the following: C1-13 as 0.1uF (100nF); C14-15 as 10uF 25VW; C16 as 27pF; C17-22 as 47pF. There are 21 capacitors in the parts list, but 22 on the circuit. Which is correct – the circuit or the parts list?

Also, the photograph of the completed card on page 88 has a different layout to that of the screening diagram on page 92. Further, the screening layout on page 92 shows a different arrangement of capacitors C16-22 to that on the screened PCB I received from ECI.

The photograph (p88) identifies the crystals as Y1 and Y2, while the screening diagram shows them as XTL2 and XTL1 respectively. Based on the values I can discern from the photograph, I have assumed that Y1 is XTL2, and Y2 is XTL1. Is this correct?

Does the 72C81 need special care when handling – for example should I earth myself when inserting this chip into its socket? Also, can I use 120ns DRAMS (4464) instead of the specified 100ns? (P.M., Queanbeyan, NSW)

Here's the second letter, with a different problem concerning this same project...

We recently constructed the Multimode Video Card, and had a few problems. For starters the card will not display graphics in the HGA mode using either a TTL monitor or an NEC multisync II monitor. However, CGA and double scan modes work OK for text and graphics. It also displays text in HGA (or MDA) modes.

In Hercules mode we observed the desired graphics image beneath an array of discontinuous horizontal lines. We believe our kit is from the latest batch from the USA. The numbers on the 72C81 CGMA chip are CQ00750, 609-3400441, 8826N. (L.W., CSIRO, Sydney)

• We received the following replies from Energy Control International. Regarding the second query, the problems being experienced should be corrected by reversing the position of DIP switch 3 – the memory wrap selector.

The many problems raised by P.M. concern the parts list. In brief, the circuit diagram as printed in EA is correct, but the parts list contains many errors. The corrections required are as follows.

Crystals; XTL1 and XTL2 have a preferred value of 20.480MHz and 16.257MHz respectively. Resistors; R1 and R2 should be 680 ohm, R3, R4 and R5 should be 220 ohm (all 1/4 watt). Capacitors; C1 to C3, C6 to C13 are 100nF monolithic (10nF can be used), C14 and C15 are 10uF 16VW, C16 is 27pF (don't exceed this value, if unavailable omit C16), C17 to C22 are 47pF ceramic.

Note that C4 and C5 are not required on PCBs using the 72C81 IC, as this chip does away with two DRAMS (IC4 and IC5) and the two associated bypass capacitors. Most kits have the 72C81, although original development of the card was with the 72C80.

The reference numbers used above are the same as those on the PCB overlay. The 72C81 should be handled carefully as it is a CMOS device. When inserting the IC into the socket, avoid touching the IC terminals, and insert the IC last during construction. Although 100ns DRAMs are specified, 120ns types can be used.

ECI have also advised that a revised demonstration disk is available for the card for $12, pre-paid only.

MIDI software

• Last month we had an enquiry concerning software for our MIDI projects – the Universal MIDI output device (Dec 87), and the Apple MIDI card (Nov 88).

We can now announce that software for the Apple MIDI interface is available and that we expect a package for the Universal MIDI interface (IBM) any day.

The Apple software includes programs that allow you to connect a MIDI keyboard to the card and record

from the keyboard directly to the computer. Then, once the recording is complete, the software will allow the recording to be played back via the MIDI instrument.

The software features variable speed playback and the record quantizing can be set prior to recording. It is a no-frills package, and disk saves and loads must be performed separately by returning to BASIC. However, all it will cost you is our usual $5.00 fee – although you must send us a blank 5.25" disk.

It is intended to extend the software into a more sophisticated package as time permits. This package will then allow multi-track recording, editing, step play and record, disk handling routines etc. When this package is ready, I will let readers know through these columns. However, this software will be a bit more expensive (perhaps around $50).

You can order the basic software package now, (Apple only). Just write to our usual address – but include the disk and $5.00.

The 'LOL' was right

Little old lady (LOL) stories abound – here's yet another. It was related to me by a TV servicing friend some years ago, and I've being desperate to tell it ever since.

It seems the LOL phoned my friend asking if he fixed televisions. Following the affirmative response, and his usual question of what's wrong, the dear old soul stated that the battery was flat in her telly. The set, by the way, was a valve type 240V AC black and white. (I did say a few years ago...)

Amidst hidden guffaws, an appointment was made, duly kept some few days later. Upon arrival, my friend organised his client into making him a cup of tea while he removed the back from the old set.

And there, hanging by two wires from the back of the vertically mounted TV chassis was a tired, leaky old D cell. As flat as a lizard drinking, to quote the vernacular.

My friend immediately put two and two together and made frantic excuses concerning the need to 'see if his truck was still OK'. It took him but a few minutes to run to the nearest corner store and purchase a new battery, which, as you probably guessed, fixed the set.

He figured that a previous serviceman had found the set would work if a particular point was biased to 1.5V, probably during ohmmeter checks while the set was on. A simple, if rather inelegant solution was to hang a battery between the required points. And my friend wasn't about to argue with the reasoning – would you?

Why??

I have a BC547, silicon small signal transistor that I know functions perfectly. It should, as it is brand new.

Why, then does an ohmmeter show conduction when it is connected between the collector and emitter of the BC547, but only when the collector is negative compared to the emitter? And why does the ohmmeter show conduction both ways across the base-emitter junction? In fact all the BC547s and 548s and 549s (and so on) I have in stock do the same thing.

The ohmmeter by the way is an AVO 8, on its R x 100 setting. The AVO 8, in case you don't know, is an industry standard analog multimeter that costs an arm and a leg, but is virtually indestructible. It uses a 1.5V and a 9V battery on its ohms ranges. *(Answer next month)*

Latching relay

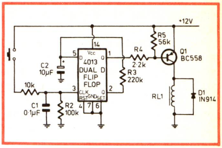
I am looking for a circuit of a relay which latches on with one pulse of 12V DC and unlatches with a second pulse. Have you ever published such a circuit, or can you refer me to a book containing such a circuit please? (R.B., Scarborough, WA)

- There are many ways to implement this circuit. It is also possible, using relay logic, to do it with two relays.

Basically the function required is that of a bistable multivibrator or 'flipflop'. The simplest way is to use a digital flipflop chip, which should be a CMOS type for the 12V specification. The 16-channel mains interface project in this issue has such a circuit, using a CMOS 4013 D type flipflop.

I've used this circuit as the basis of the circuit in Fig.1, which performs the task you asked for. Note the diode across the relay – important to limit the relay coil's back EMF from destroying the transistor and the IC!

One hassle with any digital circuit is switch bounce, and resistors R1, R2, and R3, with capacitors C1 and C2 prevent contact bounce from the pushbutton causing double toggling of the flipflop.



There are other ways of implementing R.B.'s request. A simple SCR flipflop circuit was presented in Circuit and Design Ideas (Dec 88) that could easily be adapted to drive a relay.

In the January issue of EA, a touch switch that drives a relay was presented. The touch pad could be substituted with a pushbutton, and the circuit will operate from 12V.

Lots of ways to 'skin pussy' – take your choice, R.B.

Answer to last month's Why??.

The question was, explain why the product of a resistance value and a capacitance (R x C) gives the dimension of time. OK, here's why:

Capacitance (C) = charge in coulombs (Q) divided by volts across the capacitor (V), i.e., C = Q/V. The coulomb is a measure of current (I) x time (T). E.g., a current of 1 amp equals 1 coulomb per second, where 1 coulomb equals 6.25 x 10^{18} electrons. See how time is entering the equation? So C = (I x T)/V.

Resistance is equal to volts divided by current, i.e. R = V/I. The voltage value across the capacitor is usually different to that across the resistor, but they both share the same unit – the volt.

Rewriting the equation of R x C gives (I x T)/V all divided by V/I. As a result, the I's and the V's cancel, leaving only T (seconds). It also works out that RC equals the time for the capacitor to reach 63% of the applied voltage, but that's a story for another time. (Aahh, get off!)..

NOTES & ERRATA

POWER CONVERSIONS 300W INVERTER (Dec 88): The price stated at the end of the review is obviously incorrect. The unit is priced at $495.00 plus tax.

50 and 25 years ago..

"Electronics Australia" is one of the longest running technical publications in the world. We started as "Wireless Weekly" in August 1922 and became "Radio and Hobbies in Australia" in April 1939. The title was changed to "Radio, Television and Hobbies" in February 1955 and finally, to "Electronics Australia" in April 1965. Below we feature some items from past issues.

RADIO, TELEVISION and HOBBIES

February 1964

Push Button Telephone: A new type of telephone using push buttons instead of the rotary dial is currently being tested in the USA by the Bell Telephone Company.

The new system, called 'Touch Tone', represents a completely different concept in telephone calling and signalling. The standard dial is replaced by a 10-button keyboard arrangement and each button carries the same number and letter designation as the corresponding hole in the rotary dial on a conventional telephone. As each button is pressed, a cates the number has been sent to the central office equipment.

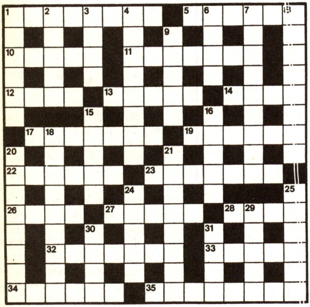
The major differences between the Touch Tone and current rotary dial telephones is in their basic operating system. With the new system, signals are alternating current tones which are similar to some of those in the human voice. These voice frequency tones are produced by a new type of signal generator in the telephone set itself. When one of the buttons is pressed, the signal generator produces muscial tones that identify the digit. Each digit is represented by a different combination of two discrete frequency tones. Designers have selected these frequencies to minimise the possibility that frequencies present in speech, music and noise, could imitate a digit, and thus cause wrong numbers.

Muscle Voltage Operates Artifical Hand: Myoelectric control of prostheses (using electrical impulses from a patient's own muscle to control an artificial limb), offers advantages over conventional mechanical or transducer controlled artifical limbs. No physical force is required, only mental concentration. A patient needs only to think about closing his missing hand and the artifical hand closes electromagnetically. Muscle potentials, termed emg signals, can be detected at the surface of the body using small plane electrodes pressed against the skin of the desired muscle. However, the total electrical activity at a given time is randomly distributed along the muscle mass and only a sample is detected by surface electrodes, so the detected signal is only roughly proportional to the mental contraction. Similarly, the emg signal fluctuates, even at constant muscular tension, around a mean value. There is crosstalk between the emg of a muscle and that of its antagonist, the magnitude varying among patients and with the siting of pick-up electrodes. The crosstalk is generally 10 to 15 dB below the desired signal from the active muscle.

CROSSWORD

ACROSS

1. Electronic media transmission. (8)
5. Energy source for some soldering irons. (6)
10. Displays that could use electroluminescent panels. (5)
11. Electronic giant created in Holland. (7)
12. Self-actuating short? (4)
13. Silicon-controlled bidirectional switch. (5)
14. Metric prefix for factor of ten. (4)
17. Brain activity. (7)
19. Press release tells how data is put in! (6)
22. Pertaining to element 92. (6)
23. Communicated information. (7)
26. This often travels by bus. (4)
27. Having unidirectional action. (5)
28. Add impurity to a semiconductor. (4)
32. Crystal growth. (7)
33. Section of domestic TV circuit. (5)
34. Minute part. (6)
35. Electronic message. (8)



DOWN

1. Name of cable linking Australia. (6)
2. Characteristic of EL display. (5)
3. Alternative to electronic funds. (4)
4. New generation of VCR. (5,1,1,1,)
6. Maker of CompuPak kit. (3-1)

JANUARY

	C	O	M	M	U	N	I	C	A	T	I	O	N	
B		C		I		I				O		U		T
A	C	T	I	N	I	C		U	N	L	A	T	C	H
R		U		E		K		N		L		P		R
C	O	P	Y		M	E	D	I	A		M	U	T	E
O		L		S		L		D		S		T		E
D	R	E	A	M	S		R	E	A	L	I	S	M	
E				O		D	I	N		I				I
	D	E	S	K	T	O	P		E	D	I	S	O	N
P		N		E		W		N		E		P		S
L	O	G	S		M	E	N	U	S		T	E	X	T
U		L		M		L		C		P		C		A
G	U	I	T	A	R	S		L	E	A	D	T	I	N
S		S		S				E		G		R		T
	T	H	E	S	E	R	V	I	C	E	M	A	N	

7. Get 23 across on an —— machine. (9)
8. Base in Telecom network. (8)
9. Launch vehicle for Gemini spacecraft. (5)
15. Switch on appliance automatically. (3,2)
16. Detect a physical condition. (5)
18. A pulse that's personal. (9)
20. Obsolete. (8)
21. Large unit of 26 across. (8)
24. Sound-ranging system. (5)
25. Large unit of resistance. (6)
29. Ionic could be this if not of charges. (5)
30. Said of certain sound reproduction. (2-2)
31. A control electrode. (4)

Forum

Continued from page 33

He noted that anyone familiar with human behaviour studies would recognise the signs of an old man fighting to keep up with progress. Hence the letter to Michael Hannan, to recommend that in order to get *EA* back on the rails, Jim Rowe be retired...

Fair enough, he's certainly entitled to his opinion. Perhaps I did get a tad emotional in response to some of those rather insulting letters from SAA protagonists, too – sorry about that, but it's sometimes hard not to get a little heated when you feel you're in the right, and being criticised unjustly.

But retire me? In the normal course of events, it is a bit early at this stage (like about 15 years – sorry to get your hopes up!). Although I won't necessarily say no, should you all decide to take up a collection and make me a presentation of a suitably large cheque, to speed things up. Just make it out to 'The Jim Rowe Retirement Fund' – all donations gratefully accepted!

Seriously though, sometimes the grind of getting the magazine out each month does get a little wearing, especially mornings after half the building has burnt down. Retirement can seem an inviting prospect, even though when I do so I'll probably be bored out of my tiny brain.

So I asked Michael Hannan whether he was unhappy about the controversy that had been generated, and wanted to put me out to pasture. His reaction was short and sweet: "If getting your readers involved like this is bad, let's have more of it!"

Perhaps retirement isn't likely for a while yet then. Ah well, it was a nice thought while it lasted!

And with those comments I think we'll give the double insulation and circuit symbol topics a rest, at least for the time being. Next month I hope to tackle something new again – a subject which should be of interest to almost all of our readers, both amateur and professional.

I hope you'll join me – or at least send a contribution to the retirement fund!

Cabling & Connectors

Continued from page 47

standard, and many printers are fitted with this type of plug. The pin connections for this type of connector are included in the data sheet.

Terminal strips are a basic type of connector that provide a means of terminating or joining wires using screws to lock the wires into the connector. PCB mount types are very useful where a semi-permanent connection is required.

The IDC (insulation displacement) format, available in a wide range of multiway connectors, permits ribbon cable to be attached to the connector by merely compressing the fitting over the cable to cause the connection to be made. Special IDC cable must be used, with this arrangement permitting an almost instant connection to, for example, 40 individual wires.

There are many IDC connectors now available, including most type of D subminiatures, Centronics connectors, PCB edge connectors and a whole range of connectors that have no equivalent other than the IDC type.

The most common IDC connector is probably the IC header, and the sizes vary from 8 pin to 40 pin. As well, there are IC sockets made in an IDC version, again in various sizes. For example, interconnecting two PCBs with a ribbon cable fitted with an IDC IC plug to either end is an elegant way around an otherwise rather messy problem.

In summary, a connector must be compatible with the wire size, be able to handle the required power, suit the environment and be correct for the type of signal being coupled. It is best to go for quality connectors, to avoid electrical 'noise' being generated, or an intermittent connection occurring.

If you have read my previous articles on fault finding, (*EA* Dec and Jan), you may recall that many faults occur in and around connection points. It pays to use the best connectors you can afford, as the bargain versions will eventually fail. Good metal doesn't come cheap these days.

Silicon Valley

Continued from page 69

$US16 million in cash for the operation, and as much as $US10 million more in royalties on future sales of the ion implantation equipment.

Seagate losses bigger than expected

Seagate posted a larger than expected loss for its most recent first quarter. The Scotts Valley disk drive maker said its red ink added up to $US52.8 million, compared to a $US14.7 million profit a year ago.

The large loss came despite a nearly 40% increase in sales, from $US226 million to $US303.2 million. Seagate had earlier announced it would report a loss for the quarter, but the amount proved about twice as large as what most Wall Street analysts had anticipated.

Seagate's problems stem from the firm's apparent error in building some $US300 million worth of new production facilities. Unfortunately, these plants came on-line right when sales of personal computers started to slow down earlier this summer, leaving Seagate with huge inventory problems that has forced it to take millions of dollars in inventory write-offs.

The company didn't specify how much of the $US52 million loss resulted from its inventory control problems.

Vintage Radio

Continued from page 135

as can be seen from the position of the centre one in the photograph, with no stops on the tuning capacitors, they could be rotated through 360°.

A-K eye appeal can be seen in the two filament rheostats controlling receiver gain, which were combined with the on/off switch in a stylish unit – much more attractive than conventional knobs.

The remaining feature of the front panel was the little name plate. These should be polished with care because, typically, they were gold plated!

Few other components were needed in these early radios. There was a 0.3uF HT bypass capacitor, and a couple of mica capacitors in the detector. A short piece of resistance wire of about one ohm was used as a filament resistor, reducing the voltage to five whilst it simultaneously provided bias for the first audio stage.

As grid leak detectors are at their most sensitive with a small positive grid bias, a tapped wirewound resistor across the filament line provided a suitable return point for the grid leak resistor. Most grid leaks of this era were removable and were of similar size and appearance to glass automotive fuses.

No radio of this era was complete without a horn speaker. Normally these horns, which were driven by oversized headphone type units, were made of wood, paper mache or very commonly, spun aluminium. Not so Atwater Kent's horns. He considered these materials to be inferior and all his horns, including the type 'L' illustrated, were made from pressed steel and weighed considerably more than their contemporaries. Finished in dark brown wrinkle enamel, the type L horn speaker is a fitting companion to the 20C receiver.

EA marketplace EA marketplace

ADVERTISING RATES FOR THIS PAGE

SMALL ADDS: The minimum acceptable size of 2 centimetres x one column costs only $50. Other sizes up to a maximum of 10 centimetres are rated at $25 a centimetre. CLASSIFIEDS: $4 for 40 letters. Just count the letters divide by 40 and multiply by $4, ROUND UP TO NEAREST WHOLE NUMBER. CLOSING DATE: Ads may be accepted up to the 18th of the month two months prior to issue date. PAYMENT: Please enclose payment with your advertisment. Address your letter to THE ADVERTISING MANAGER, ELECTRONICS AUSTRALIA, PO BOX 227, WATERLOO, NSW 2017.

FOR SALE

RADFAX2: Hi-Res radio facsimile morse & rtty program for IBM PC/XT on 360K 5.25" floppy + full Doc. Need CGA, SSBhf, FSK/Tone decoder. Has re-align auto-start view save print. Also "RF2HERC" same as above but suitable for hercules card, and "RF2EGA" for EGA card (640X350 mode). Programs are $30 each + $3 postage ONLY from M. Delahunty, 42 Villiers St., New Farm, 4005 QLD. Ph. (07) 358 2785.

8007 EXP. FILM: 10" x 12" $22 per box of 10 sheets — Portable RF generator for induction heating cheap (03) 755 2601 A.H.

STROBOSCOPE; Dawe Strobosun Hi Power Model. Perfect as new condition with handbook. Replacement cost $4006. Sell best offer (02) 648 1117

PLASMA BALLS, JARS, ETC: From $80. Balls from 250ml up to 450 litres, with or without power supplies. All designed, built in Australia. Custom Special Effects. Phone Studio of Arts and Sciences (02) 319-2427.

PRINTED CIRCUIT BOARDS
Minimum postage & packaging on all EA & ETI Project PCBs.

PCBs made to order — 48 hr prototype service.
Bankcard/Mastercard.
Acetronics PCBs
112 Robertson Rd, Bass Hill 2197
(02) 645 1241

LASER OPTICS
Build yourself a Laser and Save Big **Bucks.** Kit Includes, Laser Tube, Transformer, Board, Wiring, Case, Caps, Resistors, Transistors. **Many Uses** — Discos, Relay Activation 300 Metres, Levelling, Security Effects, Alignment.
Buy Now and Save **Hundreds.**
Price $435 Includes Postage Phone (08) 296-7464 Till 9 p.m., Or Send For an Info Pack to
LASER OPTICS.
3 Tarnham Road, Seacombe Heights S.A. 5047.

MAGNETRON TESTING

By Return Mail
All domestic and commercial oven magnetrons to 1000 watts. Result sheet provided. Tag with return address, pack securely.
Include cheque or money order for $14 test fee plus $7 post and handling.

Mail to:
Service Electronics, 2 Provost Street,
North Melbourne 3051

Phone: (03) 326-6220
Replacements for faulty units post free from stock at competitive prices . . .

AMIDON FERROMAGNETIC CORES: Large range for all receiver and transmitter applications. For data and price list and 105X220 SASE to: R. J. & U. S. Imports, P.O. Box 157, Mortdale, N.S.W. 2223. N.S.W: Geoff Wood Electronics, Lane Cove. Webb Electronics, Albury. A.C.T.: Electronic Components, Fyshwick Plaza, Vic.: Truscott Electronics, Croydon. W.A.: Willis Trading Co., Perth.

EX-ABC AUDIO TAPES: ¼" wide on 10½" **Standard** metal spool $6.85. **Robust** metal spool $12.85 7" spool $2.85. 5" spool $1.25. Post extra. Also in stock ½", 1" and 2" tapes. Waltham Dan, 96 Oxford St., Darlinghurst, Sydney. Phone (02) 331-3360.

BUILD YOUR OWN LED: Moving Message board. $75 for a 4 character display experimenters short form kit and $150 for 16 characters. Include PC boards Eprom and full instructions to complete project to a professional standard. Loaded from Centronics printer port, or PC/XT keyboard. Equiv commercial units start at around $1000. For more info send a 39c stamp to Don McKenzie 29 Ellesmere Crescent, Tullamarine 3034.

NEW RADIO VALVES: For entertainment or industrial use. Waltham Dan, 96 Oxford St., Darlinghurst, Sydney. Phone (02) 331 3360.

RCS RADIO PTY. LTD.
Established 1933
IS THE ONLY COMPANY
WHICH MANUFACTURES AND
SELLS EVERY PCB & FRONT PANEL
published in EA, ETI & Silicon Chip
651 Forest Road Bexley 2207
AUSTRALIA
RING (02) 587 3491 FOR INSTANT PRICES
24 HOUR TURNAROUND SERVICE

WANTED

ELECTRONICS TECHNICIAN: Required 2-3 days per week for small repair workshop. Contact Martin Griffith. Switchmode Power Supplies. 2 Avon Road, North Ryde. Telephone (02) 888-9371.

LISTING OR PROMS: For SIMON 80 monitor. R. Hall P.O. Box 709, Bridgewater 5155

KIT REPAIRS!
Repairers of all EA, ETI,
AEM and Silicon Chip projects.
Got a problem! Or queries;
Ring any time 9 am-9 pm Mon-Sun
EEM ELECTRONICS
10 Bouverie Place, Epping 3076
(03) 401-1393

A NEW CONCEPT FOR LOW VOLTAGE PROJECTS
COPPER FOIL TAPE: thin pure copper tape backed by special hi-tack adhesive. Current carrying capacity, 5 amps, FULLY TESTED at 24V 5A. Not recommended for mains voltage.
4.75mm ... RRP $8.03 6mm...RRP$9.84 8mm ... RRP $13.60 33 metre rolls
GIFFORD PRODUCTIONS
P.O. Box 62, St. Kilda, Vic. 3182 (03) 534-3462

DO YOU WANT TO BE A RADIO AMATEUR?

The Wireless Institute of Australia, established in 1910 to further the interests of Amateur Radio, conducts a Correspondence Course for the A.O.C.P. and L.A.O.C.P. Examinations conducted by the Department of Communications. Throughout the Course, your papers are checked and commented upon to lead you to a successful conclusion.
For further information, write to:

THE COURSE SUPERVISOR
W.I.A. (N.S.W. DIVISION)
P.O. Box 1066
PARRAMATTA, N.S.W. 2150.

your computer

TUTORIALS
REVIEWS
NEWS
PROGRAMS

A magazine for all computer users and enthusiasts, Your Computer has something for everyone

EA Directory of suppliers

Which of our many advertisers is most likely to be able to sell you that special component, instrument, kit or tool? It's not always easy to decide, because they can't advertise all of their product lines each month. Also some are wholesalers and don't sell to the public. The table below is published as a special service to EA readers, as a guide to the main products sold by our retail advertisers. For address information see the advertisements in this or other recent issues.

Supplier	State	A	B	C	D	E	F	G
All Electronic Components	Vic	●	●	●	●	●		
Altronics	WA,NSW	●	●	●	●	●	●	●
Acetronics	NSW			●				
Chapman, Lance	NSW	●			●			
Dick Smith Electronics	All	●	●	●	●	●	●	●
Eagle Electronics	SA	●		●	●		●	
Electronic Brokers	Vic						●	
Electronic Component Shop	Vic	●		●	●	●	●	
Emona Instruments	NSW						●	
Geoff Wood Electronics	NSW	●	●	●	●	●	●	
George Brown Group	All		●		●	●	●	
Jaycar Electronics	Eastern	●	●	●	●	●	●	●
Perna Electronics	Vic				●	●		
Pre-Pak Electronics	NSW		●		●	●		
Preston Electronics	Vic	●	●	●		●		●
RCS Radio	NSW			●				
Rod Irving Electronics	Vic	●	●	●	●	●	●	●
Scientific Devices	Vic						●	
Sheridan Electronics	NSW		●	●	●	●		
Tandy Electronics	All		●		●	●	●	●
Wagner Electronics	NSW		●		●	●	●	

KEY TO CODING
A Kits & modules
B Tools
C PC boards and supplies
D Components
E IC chips & semiconductors
F Test & measuring instruments
G Reference books

Note that the above list is based on our understanding of the products sold by the firms concerned. If there are any errors or omissions, please let us know.

Electronics Australia Reader Services

"Electronics Australia" provides the following services:

Subscriptions: All subscription enquiries should be directed to: Subscriptions Department, Federal Publishing Co. PO Box 227, Waterloo 2017. Phone: (02) 693 6666

BACK ISSUES: Available only until stocks are exhausted. Price: $4.50

PHOTOSTAT COPIES: When back issues are exhausted, photocopies of articles can be supplied. Price: $4.50 per project or $9 where a project spreads over several issues.

PCB PATTERNS: High contrast, actual size transparencies for printed circuit boards and front panels are available. Price: $5 for boards up to 100 square centimetres; $10 for larger boards. Please specify positive or negative.

PROJECT QUERIES: Advice on projects is limited to postal correspondence only, and to projects less than five years old. Price: $5. Please note that we cannot undertake special research or advise on project modifications. Members of our technical staff are not available to discuss technical problems by telephone.

OTHER QUERIES: Technical queries outside the scope of "Replies by Post", or submitted without fee, may be answered in the "Information Centre" pages at the discretion of the Editor.

PAYMENT: Must be negotiable in Australia and made payable to "Electronics Australia". Send cheque, money order or credit card number (American Express, Bankcard, Mastercard, or Visa Card), name and address (see form). All prices include postage within Australia and to New Zealand.

ADDRESS: Send all correspondence to The Secretary, "Electronics Australia", PO Box 227, Waterloo, NSW 2017. Please note that we are unable to supply back issues, photocopies or PCB artwork over the counter.

Back Issues ....
....
....

Photostat copies ....
....
....

Total price of magazines/photocopies, including postage and handling.

No off issues reg .... x$4.50 = $...............

Cheque*/Money Order ☐ Please tick box to indicate method of payment:

**Please make payable to the Federal Publishing Company Pty Ltd.*

Mastercard American Express ☐ Visa ☐ Bankcard ☐ Tick ☑

Card Expiry Date ....

☐☐☐ ☐☐ ☐☐☐ ☐☐☐☐☐☐

Credit Card No

Signature ....
(Unsigned Orders cannot be accepted)

NAME: ....

ADDRESS: ....

.... POSTCODE...............

ADVERTISING INDEX

Adeal .... IBC
Adilam 21
Allen Bradley 139
Altronics 74
Companion Computers 139
Control Data 37
Dewar 45
Diamond Valley Micro Systems 131
Dick Smith Electronics 14-15,28-29,108-109
EEM Electronics 45
Electronic Broker 82
Elmeasco 35
Emona 13
Energy Control 26
Federal Publishing .... IBC, 34, 52, 114-115
Ferguson Transformers 120
Geoff Wood Electronics 53
Gifford Productions 145
Jaycar 94-97
John Barry Group 45
John C Duval Advertising 145
Kenelec 27
Knife Shop 131
Laser Optics 145
Oatley Electronics 139
Obiat 48-49
Parameters 83
Perna Electronics 17
Power Conversions 120
Powersonic Australia 107
Protel Technology 45
RAAF 38-39
RCS Design 12,86
RCS Radio 145
Richard Foot 57
Rod Irving Electronics 62-67
Scan Audio 86
Scientific Devices Aust 52
Scope Labs .... IFC
Selectronic Components 82
Service Electronics 145
Setec .... OBC
Solarex 125
Statronics 123
Stotts 133
Uni-X 87
University Paton 9
Utilux 42
Wireless Institute of Australia 145

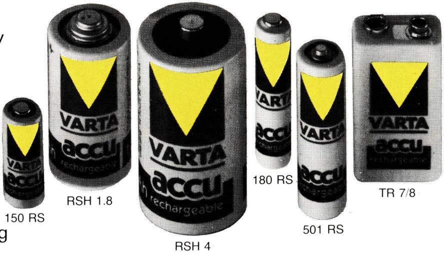
This index is provided as an additional service. The publisher does not assume any liability for errors or omissions.

VARTA

Positively the Battery Experts

VARTA NICAD RE-CHARGEABLE

The professional quality battery for the frequent user, resulting from exhaustive research, sophisticated product development and high-tech production. Recharges up to 1000 times. This is the economical alternative for constant long lasting trouble free operation.



Distributed by **ADEAL** PTY. LTD.

VIC: 150 Buckhurst St. Sth Melbourne 3205. (03) 690-4911. Telex: Adeal AA 37011.
NSW: 405 Sussex St. Sydney 2000. (02) 211-0422
QLD: (07) 299-6992. S.A. (08) 258-5865.
WA: (09) 279-8811.

MISSING ANY COPIES FROM YOUR EA COLLECTION?

BACK ISSUES STILL AVAILABLE:

SEPTEMBER 1987
Cassette Box Switch-Tuned Radio (4/MC/6)
Satellite Siren (3/AU/54)
Low Cost Experimenter's Supply (2/PS/65)

NOVEMBER 1987
Stylish Metronome (3/MS/132)
Universal Voice Operated Relay (1/RA/37)
DC Electronic Fuse (7/MS/19)
Voltage & Continuity Checker (7/M/70)
Telelink Modem Pt. 2 (2/CC/97 (B))

JANUARY 1988
Easy to Build Rengenerative Radio (4/TR3/8)
Low Cost Temperature Probe (7/MS/20)
Stereo Headphone Optical Link)1/MS/38

FEBRUARY 1988
Universal Midi Interface (1/EM/59)
Earwig: A Bug in a Matchbox (2/TR/65)
Low Cost Tester (7/VT/18)

JANUARY 1987
Low Distortion Audio Oscillator Pt.2 (7/AO/39)
3-Band Shortwave Radio (2/SW/79)
Remote Control for Burglar Alarms (3/MS/126)

APRIL 1988
Low Cost Amp/Signal Tracer(1/MA/63)
Improved 300W 12/230V Inverter (3/IT/17)
Digital Current Tracer Probe (7/ST/13)

MARCH 1987
Electronic Rain Gauge (3/MS/127)
NiCad Battery Charger (2/BC/12)
Masthead Amplifier (6/MS/20)

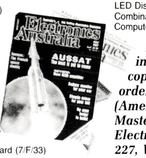
APRIL 1987
12/240V Inverter (3/IT/15)
Ultrasonic Car Alarm (3/AU/51)
Metric Clock (7/CL/37)
Crystal Oven (3/MS/128)

MAY 1987
Low Cost Mini Mixer (1/MX/18)
Car Battery Monitor (3/AU/52)
Op Amp Tester (7/MS/17)
Omega Derived Frequency Standard (7/F/33)

JUNE 1987
IR Remote Control (2/MC/24)
Car Alarm (3/AU/53)
VU Meter (1/MS/35)
Op Amp Tester Pt.2 (7/MS/18)

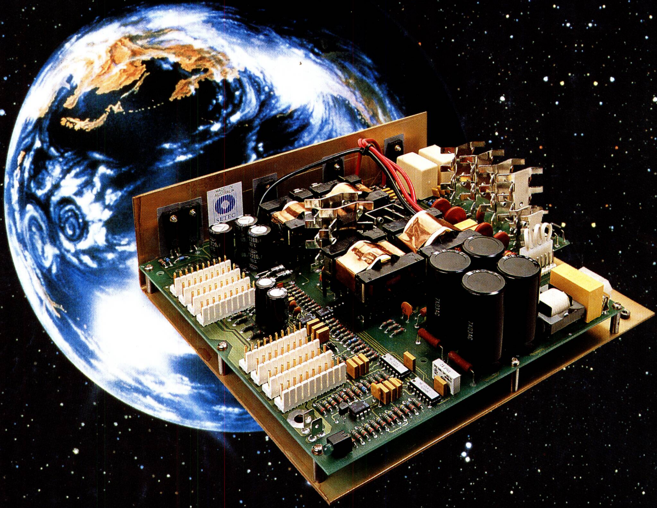
JULY 1987
CD Amplifier (1/SA/78)
IR Remote Control Pt.2 (2/MC/25)
Phase Difference Meter (7/M/69)
Electronics Trainer (3/MS/129)

AUGUST 1987
Muso Link (1/MS/36)
LED Display (7/CL/38)
Combination Lock (3/MS/130)
Computer Strobe (7/SC/7)



Back issues are $4.50 each, including postage. To order copies send cheque, money order or credit card number (American Express, Bankcard, Mastercard or Visa Card) to Electronics Australia, PO Box 227, Waterloo 2017.

The Australian power supply built to international standards



SETEC is Australia's largest power supply manufacturer. Setec can design to virtually any specified International Safety and EMI Specification such as IEC950, IEC435, IEC380, UL478, UL1012, VDE0806, VDE0871, CISPR22, CSA C22.2 No. 220 and FCC Part 15 Subpart J.

SETEC

Setec can verify safety requirements and also can measure conducted EMI to both Class A and Class B levels.

Setec already supplies International and Australian companies with power supplies complying with International Standards.

The high powered performer

SETEC PTY. LTD., 6 HOLLOWAY DRIVE, BAYSWATER 3153 PHONE: (03) 762 5777, FAX: (03) 762 9197